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ABSTRACT

This final report describes the development and evaluation of C-Print, a system for transcription of computer-aided speech to print. Chapter 1 is an introduction to the 3-year federally supported project. Chapter 2 provides background information on current speech-to-print systems. Chapter 3 focuses on needed improvements in C-Print, especially improvements in the general and specialized dictionaries and development of procedures for condensing text. Chapter 4 focuses on the C-Print captionist, including roles and responsibilities, training procedures, the training workshop, and the workshop evaluation. Chapter 5 discusses C-Print captionists' perceptions of their experiences in supporting students in the classroom. Chapter 6 reports on a questionnaire and in-depth interview studies of the system with 36 deaf or hard of hearing students at the college level. The final chapter reports on a pilot study using C-Print with two deaf high school students. An appendix lists other materials providing information on the C-Print Project. (Contains 31 references.) (DB)

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Final Report

DEVELOPMENT AND EVALUATION OF A COMPUTER-AIDED SPEECH-TO-PRINT TRANSCRIPTION SYSTEM

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Chapter I

Introduction

Michael Stinson and Barbara McKee

This report describes the work done for a project entitled, "Development and Evaluation of a Computer-Aided Speech to Print Transcription System." (Award # 180J3011) for the period of December 1, 1993 to November 30, 1996. The goals of this project were:

1. To make needed improvements in the speech-to-text system, called C-Print, specifically: (a) improvements in the general and specialized dictionaries; and (b) development of procedures for condensing text.
2. To evaluate the system in the classroom including: (a) evaluation of technical performance; (b) completion of a questionnaire study; (c) completion of an in-depth interview study; (d) study of captionists' use of the system; (e) completion of a study of the system at the secondary level.
3. To train captionists and other personnel including: (a) refinement of operator training procedures; (b) evaluation of training procedures; (c) providing workshop for secondary and postsecondary personnel.

All these goals were addressed during the project. The work on needed improvements is described in Chapters III and IV and also in the C-Print captionists' training manual (See list of materials providing information on the C-Print system). The C-Print training manual, and the accompanying audiotapes for practicing with the system, are provided to participants in workshops regularly offered to train individuals to become C-Print captionists. Sample chapters of the training manual are available upon request.

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With respect to evaluation of the system in the classroom, Chapter IV includes sections that describe the evaluation of the system's technical performance, as well as the C-Print captionists' roles and use of the system. Chapter V discusses C-Print captionists' perceptions of their experiences in supporting students in the classroom. Chapter VI reports on the questionnaire and in-depth interview studies of the system at the college level, and Chapter VII presents a qualitative pilot study of the system at the secondary level.

A third general goal of the project was to train captionists and other support service personnel regarding the C-Print system. Chapter IV contains information regarding the training procedures, the workshop for training captionists, and the evaluation of the workshop. The C-Print captionists' training manual also, of course, is a product of much of the work to develop captionists' training procedures.

Staff involved in this project were awarded a subsequent grant to continue this work, "Implementing a Computer-Aided Speech-to-Print System as a Support Service to Deaf and Hard of Hearing Students,"(Award # 180U6004) from the Department of Education, Office of Special Education, that is currently in progress. Outreach activities of the project have benefited from NTID being named as the Northeast Technical Assistance Center to advise postsecondary programs for the deaf and hard of hearing in the Northeast (Department of Education Award #H078A6004). To date, these additional funds have supported the development of additional materials, as well as further work in implementing and disseminating the C-Print system. The appendix contains a selected list of currently available materials on the C-Print system. Papers that appear redundant with information in the final report or with other materials in the list are not included. Thus, much additional information and materials regarding C-Print are continuing to be developed and distributed.

Successful completion of the initial project would not have occurred without the collaboration and dedication of an outstanding staff. This staff consisted of captionists Joyce Gambacurta and Barbara Paine, project coordinator Pam Giles-Francis, secretary Gina Coyne, and researchers Lisa Elliot, Vicki Everhart, Janette Henderson, and Susan Stinson. The staff of the Department of Educational and Career Research, especially Ron Kelly, Gayle Meagan, and Yufang Liu also contributed significant help at times. The project also greatly benefited from a group of advisors that included Gerry Buckley, Susan Dauenhauer, Ann Hager, Alan Hurwitz, Gary Meyer, Harry Levitt, Marty Nelson-Nasca, John Schroedel, and Ross Stuckless. We are also most appreciative of the deaf and hard of hearing students at the Rochester Institute of Technology and the Board of Cooperative Educational Services of Monroe County high school students who tried the C-Print system and who provided feedback to us and to their instructors who welcomed us into their classrooms. Finally we are grateful for the continuing support of NTID for development of the C-Print system.

Chapter II

Current Speech-to-Print Systems: Background

Michael Stinson

Providing for adequate communication for deaf and hard of hearing students in the mainstream classroom is a complex and challenging task. One reason for this complexity is that students vary considerably in their communication needs in mainstream classes. Some have grown up with sign language and are most comfortable with an interpreter who incorporates much American Sign Language into the interpreted message. Others are hard of hearing students who do not know sign language, but who attempt to understand the instructor and classmates through lipreading and residual hearing. In dealing with the diverse communication needs of the students, a reasonable approach is to provide the support services best tailored to the individual student's needs, within constraints such as costs and availability. The traditional support services of interpreting and notetaking serve some students adequately. Frequency Modulated (FM) systems are also helpful to many students. Real-time speech-to-text transcription systems may also be an effective form of support for many students, and one such system developed at the National Technical Institute for the Deaf (NTID) is the focus of this report.

Currently, in implementing speech-to-print services as a support for deaf students, there are two major options: (a) One is a steno-based system in which a trained stenographer using a stenotype machine keys in a stenographic code which is then converted in a computer into English for display on a monitor in real time. Generally, the stenotypist records virtually every word spoken. (b) A second option is computer-assisted notetaking (CAN) in which a typist or operator with a standard keyboard (usually a laptop) keys in the words as they are being spoken.

Some operators type summary notes; others type near verbatim text (Stinson, Eisenberg, Horn, Larson, & Levitt, 1997; Stinson & Stuckless, in press).

The speech-to-text transcription system developed at NTID is called C-Print because it is computer-aided and because it provides a printed display. It is a CAN system which emphasizes the typing of near verbatim notes. A hearing operator keys in what the speaker is saying and a real-time text display of the message appears on a computer or television monitor approximately 3 seconds after the words are spoken which the student can read to understand what is happening in class. Note that we use the term real-time here. This means that the speech is transcribed into a text display as the words are being spoken. This is in contrast to approaches that prepare the text ahead of time such as most captioning of television programs. In addition, the text file stored in the computer can be examined by students, tutors, and instructors after class by reading a computer monitor or a hard-copy printout.

Increase in Mainstream Programs

Since the 1960's, there has been rapid growth in mainstream educational programs at the secondary and postsecondary levels (Ficke, 1992; Moores, 1992; Rawlings, et al., 1988). According to the National Institute on Disability and Rehabilitation Research (Ficke, 1992), during the 1988-89 school year more than 57,555 deaf and hard of hearing children between the ages 6 and 21 were provided special education under P.L. 94-142 and P.L. 89-313. Approximately 70% of these students are educated in public school settings (Schildroth, 1988), and approximately 75% of these students are at least partially mainstreamed (Kluwin & Stinson, 1993). Secondary level mainstreamed students use educational interpreters in over half of their classes (Rittenhouse, Rahn, & Moreau, 1989). Some students who use interpreters, particularly those who desire word-for-word transliteration and those from oral programs, might benefit as much—or more—from use of a transcription system (Zawalkow & DeFiore, 1986). Also there

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are probably even larger proportions of mainstreamed students who are not using interpreters who could benefit from a transcription system.

At the postsecondary level, the number of programs for deaf students has increased dramatically so that now approximately 10,000 students are served (Walter, 1992). Programs for these students vary from large comprehensive programs, such as Gallaudet University and NTID, to the small one with only a few deaf students. The typical program is one with 10-20 students and with only a part-time administrator. In a large majority of these programs, students are mainstreamed for most of their classes (Walter, 1992).

Communication Difficulties

For many of these mainstreamed students, a major concern is the adequacy of classroom communication, and there is good documentation of the communication difficulties faced by deaf students in mainstreamed classes (Jacobs, 1977; Osguthorpe, Long & Ellsworth, 1980). For example, Foster and Elliott (1986) interviewed 20 students who transferred to the National Technical Institute for the Deaf (NTID) from other postsecondary institutions. The researchers noted that students had been particularly hampered by communication difficulties even when an interpreter and additional support services were provided. The transfer students complained that teachers frequently moved through the material too quickly, were impatient, and treated deaf students as though they could hear. As one student commented:

> *Some of the teachers (at mainstream college), they had no experience with deaf ... they talk real fast. If I had a question, I'd have to raise my hand and stop the interpreter, stop the teacher. Then they'd explain and I'd have to turn over here (look back and forth) and it was really a pain (p. 12).*

Ten years later a study by Stinson, Liu, Saur and Long, (1996) found students in mainstream classes expressing similar complaints, although there were individual differences in the extent of difficulty reported. Though the instructional conditions at the secondary level are

somewhat different than those at the postsecondary level, the difficulties faced by deaf and hard of hearing students in mainstream settings in understanding the teacher and in participating in class discussions and activities have also been well documented (Kluwin & Stinson, 1993; Libbey & Pronovost, 1980). One example of these difficulties is being able to understand hearing classmates. Many hard of hearing and some deaf students use Frequency Modulation (FM) systems to supplement their lipreading of the teacher. Usually the FM microphone is worn by the teacher. When the student's hearing-aids are switched to receive the FM input, they generally cannot hear their classmates' discussion. An interpreter could convey the students' discussion, but students who use FM systems often have poor receptive sign skills.

It is important to provide the students experiencing such difficulties improved access to the information presented in class. An additional consideration is that mainstreamed students sometimes do not have access to classroom information because no interpreter is available. For example, in 1991 the State of Massachusetts had 4,500 hours of unserved requests for educational interpreting and the situation is worse in other states (Menchel, 1995). A speech-to-text transcription system such as C-Print may be an effective way of providing communication access for many mainstreamed students. A transcription system may also enable programs to provide services to deaf and hard of hearing students where none are currently available.

Importance of Printed Information

One impetus for the development of transcription systems for use with deaf students as a support service has been the recognized value of printed texts as a means for access to information. When deaf college students were surveyed regarding their primary sources of information for learning, they indicated that the two most important sources were the textbook and notes (Stuckless & Enders, 1971). Studies comparing the comprehension of captioned or printed information, as opposed to that conveyed by a sign language interpreter suggests greater

comprehension of printed information (Gates, 1971; Stinson, Meath-Lang & MacLeod, 1982). Comprehension of information also increases when deaf students have an opportunity to review detailed notes of lecture material after first viewing an interpreted presentation of the lecture (Osguthorpe, Long, & Ellsworth, 1980).

Current Transcription Systems

The C-Print system is a form of computer-assisted notetaking. Steno-based systems are also used to transcribe into text, in real-time the spoken language of the classroom setting.

Steno-based Systems

Stenobased systems have been used in the classroom for approximately 15 years. Special equipment is needed, and the operator will need to have had extensive training, typically two years, in order to use the stenotype machine effectively. Stenowriting (using a 24 key steno-machine as used by court reporters) permits phonetic recording rates well over normal speaking rates (Haydu & Patterson, 1990; Smith & Rittenhouse, 1990). Certification as a Registered Professional Reporter begins at 220 words per minute (wpm). While stenowriting is not constrained by speed of input, it does have two major constraints: (a) scarcity of qualified stenographic reporters, especially at the local level; and (b) cost, (the published hourly fees range from $30-$150 per hour; Stuckless, 1994) especially when the services are being provided to a single student in the mainstream classroom. Results of studies evaluating the system have shown steno systems to be an effective support service for some students.

During the 1980's, researchers at NTID implemented a steno-based system for transcribing speech into print in real-time as a support service in classes at RIT. In the real-time graphic display (RTGD) system used at NTID, the text generated by the stenographer was displayed on a television screen in real-time for the deaf and hard of hearing students to read during class. After class, a hard-copy printout was made available to these students. A

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comprehensive evaluation of this steno-based system was conducted by Stinson, Stuckless, Henderson & Miller (1988) at NTID. Questionnaires were administered to 121 deaf and hard of hearing RIT college students served by RTGD. These students' responses to the questionnaires indicated that they understood more information with RTGD than with an interpreter. Further, the students rated the printout provided by RTGD as more helpful than notes provided by paid student notetakers. Conversations with students suggested that one reason they found the printout to be helpful was that the detail of the verbatim, hard-copy text provided clarification of what was not understood during the lecture. These results regarding the benefits of the printout are also congruent with Kiewra's (1985) conclusion based on an extensive review of research on notetaking: Having all of the lecture's critical ideas, with much elaboration of these points, is desirable for optimal learning.

Demographic and communication characteristics were related to students' responses to the questionnaire. Students who were mainstreamed in high school programs and who had relatively high proficiency in reading, writing, and speechreading were likely to prefer RTGD. These results suggest that some deaf and hard of hearing students in some classes respond at least as positively to a steno system as to an interpreter or a notetaker. In most college and university programs, however, the hearing-impaired students do not have interpreting services in classes where they have a steno system, although they may have notetakers.

Computer Assisted Notetaking (CAN): Computer Systems with Standard Keyboards

A number of such systems have been developed and they have variations. In general, these systems involve a (hearing) operator transcribing information as it is spoken in class on a laptop computer using a commercially available word processing program (such as Word Perfect) and a standard keyboard. In real-time, the text is displayed for deaf and hard of hearing students to read on a TV monitor or a second laptop (depending upon the number of

mainstreamed students in class). At the end of class, the text is saved as a word processing file which can be corrected, printed, and distributed as a hard copy to students. Therefore, the client is provided with a real-time display of information spoken in class, as well as a hard-copy printout of that information after class. In being able to provide both types of information, these systems are similar to steno-based ones.

These systems use standard typing as their starting point, and performance may increase through use of special strategies. A limitation of this approach is that these systems cannot provide a word-for-word transcription, since they cannot keep up with the speed of speech, approximately 150 words per minute, as used by college instructors. There are a variety of ways that such typing can be used in the classroom. One approach is simply the typing of notes rather than the writing of them—that is, the typist takes down in summary form what the teacher says. Such notes may be valuable; however, they fail to capture the nuances, specificity, and flavor of speech that is necessary for true access. On the other hand, the typing of fewer words may help some deaf students comprehend the important ideas.

Advantages of CAN systems are that they use portable, low-cost equipment, there appears to be a large pool of potential operators, and pay for their services may be less than that for stenotypists and interpreters. In general, training is brief, and depends on the specific goals of the system. In 1989 researchers at NTID began to develop a specific CAN system, C-Print, in response to problems of portability, cost, and availability with respect to steno-based systems.

Chapter III

Description of the C-Print System

Michael Stinson, Barbara McKee, Lisa Elliot, Vicki Everhart,

Janette Henderson, and Pam Giles-Francis

The goal of the C-Print system is to come as close as possible to capturing spoken text word-for-word and takes a systematic approach to including all relevant information. Basically, two strategies are employed to enable the C-Print system to capture as much of the information as possible: (a) a computerized abbreviation system to reduce key strokes; and (b) text-condensing strategies that permit the captionist to type fewer words while capturing the information of the spoken message.

Equipment

The C-Print support system uses affordable equipment. The current system uses standard laptop computers with a DOS (IBM compatible, e.g. IBM Thinkpad) operating system and a regular keyboard. (The computer and software can be purchased for as little as $2,000). For display purposes, a second laptop computer or a VGA adapter (to connect to a regular TV monitor) can be purchased. An asynch cable may be used to connect the two laptop computers with each other. When there are two laptops, the operator and student can conduct two-way communication. This means, for example, that if a student wants to ask a question or make a comment in class but does not want to voice it, he or she can type the message and the operator can read it aloud to the class. To achieve this communication, software (e.g. Carbon Copy, Timbuktu) is used that creates an asynchronous link. This software provides two ways of communicating between the two computers: (a) a full-screen mode, where only one individual

can enter a message at a time; and (b) a split-screen mode where both individuals may simultaneously enter messages. In general, the C-Print project has used the full screen mode.

Abbreviation System

An additional piece of software is Productivity Plus (cost $450) that has been developed specifically for extensive abbreviation of words and phrases entered into the computer. The software automatically converts the abbreviations typed by the captionist into the full words that appear on the screen increasing typing speed without increasing keystrokes, and permitting the captionist to more closely approach the speed of the talker.

As the lecturer (or class participant) talks, the captionist types some full words and some abbreviations. For the abbreviated words, Productivity Plus searches the dictionary for the equivalent full word and displays it on the screen. Examples of C-Print abbreviations and their full expansions are listed below.

Abbreviations	Full expansion
t kfe drqr	the coffee drinker
slvg t pblm	solving the problem

The captionist does not have to memorize all the abbreviations in the system. Rather she or he learns a set of phonetic rules, developed by the C-Print project, which are then applied to any English word that has been added to the system's general dictionary. The general dictionary developed by the C-Print staff currently contains approximately 15,000 words, including suffixes. The words in the general dictionary were selected from research on word frequencies in English (Carroll, Davies, & Richmond, 1971; Francis & Kucera, 1982).

Principles/Rules

There are five general principles with their associated rules that the captionist learns. With these rules the captionist does not need to memorize all the words that are abbreviated phonetically. The general principles are as follows:

1. Abbreviate only words of five or more letters. Completely type words of four letters or less.
2. Type only the sounds you hear in a word. Do not type letters that are silent.
3. Six vowel rules (e.g. Omit all short vowels in the middle of a word, type for brother, "brthr").
4. Rules for suffixes, word endings, and common English syllables. Letters or symbols are substituted for certain suffixes (e.g. establshm for establishment, elm for element).
5. Rules for beginning syllables, such as "con," "pre," "mis," etc. (e.g. ktan for contain).

Captionists also learn an extensive set of brief forms, that must be memorized. Brief forms are abbreviations that do not follow the abbreviation rules. Many are commonly used abbreviations such as those used for the names of states and countries.

During the course of the project earlier rules were extensively modified, lessons were revised, and a revised set of audiotapes was recorded. Originally there were 40 specific rules, that were reduced to the five general principles described above. These revisions are discussed more extensively under training.

C-Print Dictionaries

The general dictionary underwent extensive modification during the project. The dictionary was expanded from 4,000 root words and 3,000 additional words through suffixes to

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8,000 root words and 7,000 suffixes, for a total of approximately 15,000 abbreviations. Additional work was done to reduce conflicts and confusions among abbreviations for words in the dictionary. Since the rules to form the abbreviations for the dictionary are phonetically based, whereas English is a morphologically-based language, certain conflicts arose in the abbreviations for words. For example, the words "peace" and "piece" should both be abbreviated as "pes." Project staff examined the dictionary to eliminate these conflicts, generally by creating a brief form for one of the conflicting words. Dealing with these conflicts did not require any major changes in the abbreviation rules.

The Productivity Plus software enables captionists to create specialized dictionaries as well as the general dictionary. When the proposal was written, we anticipated that a number of specialized dictionaries would be written for different course contents. Specialized dictionaries would contain abbreviations for specific terms, such as "dfd" that would expand to "Data Flow Diagram (dfd)." Because of potential conflicts between words in the general dictionary and those in the specialized dictionary, we proposed that there be hand checks to insure that such conflicts did not exist or were resolved if they did. We originally assumed that C-Print captionists would share use of these specialized dictionaries. As work proceeded on the project we learned that a different approach was more practical. Captionists developed their own individualized dictionaries. In these individualized dictionaries they would add abbreviations for specialized terms for the different courses they were serving rather than having different specialized dictionaries for different courses. The three captionists also found it easier to add these words to their own general dictionaries rather than putting them in specialized dictionaries. Putting the words for individual courses in these general dictionaries made it easier to check whether there was a potential conflicting abbreviation, and also it made the management of dictionaries during actual captioning easier. This approach of individualizing dictionaries by

having each captionist add their specialized words to the general dictionary is similar to the approach that stenotypists who work with computerized systems use.

The two best ways for captionists to identify words for individualizing their dictionaries have been by: (a) noting words that were used repeatedly in previous lectures that were not in the dictionary; or by (b) examining textbooks and previously taken notes for the course. In the original proposal, we considered the options of doing word frequency analyses of selected numbers of lectures, and of asking for suggestions from support staff and from teachers of the course. We have found that certain cooperative, organized teachers are able to provide notes that they plan to use for a course, and such notes are very helpful. We also found such instructors have been the exception. The primary help of support staff has been to identify old sets of notes for specific courses for which captionists have been providing C-Print services.

Text Condensing

In addition to learning abbreviations and brief forms of words, C-Print captionists were also trained in principles of text condensing. Text condensing is used by the captionists when the pace of the lecture is too fast for verbatim transcription. Captionists were presented with six principles of text condensing: active listening, strategies for condensing information, organizing information, identifying important information, eliminating redundant information, and summarizing. These principles were developed based on previous work of Clark and Clark (1977) and Verlinde and Schragle (1986) and condensing strategies utilized by persons who write captions for television. The text condensing principles are briefly described below.

Active Listening

Active listening is the ability to concentrate on the meaning that the speaker is trying to express. Operators have been given three rules of active listening that will help them follow the lecture and record it in a meaningful way.

1. Listen for cues to identify important points and relevant information. Three cues have been suggested to enable the operator to identify the important points of a lecture. Operators are encouraged to attend to words that the professor uses (e.g. "You'll need to remember this," "The basic concept here is," "Remember that," "This will be on the test"). Operators are also urged to listen to voice inflection and voice loudness.
2. Listen for cues to topic sentences and topic conclusions. Topic sentences and conclusions indicate the speaker's main points. For example, topic sentences might begin with "Today we are going to talk about," or "A major development...". Cues to topic conclusions might be "As a result," "From this we see," "All of this shows that."
3. Listen for cues to help organize information. Listen for the general organizational framework. In this case, the speaker will indicate a number of topics or points to be covered. The operator can then be sure that she has captured all the points that speaker has indicated, for example: "There are three reasons why," "In addition," or "In contrast."

Strategies to Condense Information

1. Reducing the number of words typed. Six suggestions are offered for reducing the number of words typed. (a) Eliminate nonessential words (e.g. okay, well, um, you know, let's see). (b) Reduce relative clauses to shorter phrases (e.g. "We will work

on the problems that are difficult" can be changed to "We will work on the difficult problems."). (c) Use active vs. passive voice (e.g. "The book was written by John Mortimer" can be changed to "John Mortimer wrote the book."). (d) Replace specific content with general representations (e.g. substitute general terms for lists of words—"flowers" instead of "daises, tulips, and roses"; general action for list of subcomponents of the action—"Mary moved to Greece" for "Mary packed her belongings. Mary bought a boat ticket,....."). (e) Omit misspeaks (e.g. "We needed..ah..well...So next we went to the mall..uh, I mean, I went to the mall..and shopped at Lechmere's....I mean Lechter's" becomes "So next I went to the mall and shopped at Lechter's."). (f) Lecturers often repeat, paraphrase, give specific examples, and give off-the-point or tangential information. Delete this less important language.

2. Organizing information in clear, coherent manner. This condensing rule suggests that the captionist should type important information in a way that it is easy to understand. This can be accomplished by deleting wordiness, using simple, clear language and short, simple sentences.

Identifying Important Information

Identifying important information for text condensing purposes requires listening for a statement of a topic or theme for the lecture or classroom discussion. This may mean focusing on information that the instructor has identified as important or if the instructor has been less direct, the captionist needs to mentally summarize the lecture and determine what points have been made up to that point.

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Eliminating Redundant Information and Capturing the Main Points

1. Capture the main points. Eliminate nonessential information. Judge what is of lesser importance and drop it from the C-Print text. Compare the original lecture with the version in the C-Print text:

   Original lecture: But I am suddenly aware of the fact that, yes, everything is not the way it ought to be. My car needs repair. It is not reliable. My wife is starting to nag me, etc. I have a problem. What is the next step?

   C-Print text: *I am suddenly aware that my car needs repair. I have a problem. What is the next step?*

2. Eliminate redundant information. Preserve the content of the communication, but avoid repetition. For example:

   Original text: We are talking about those personal factors. We are talking about my perception of roles in the family, and family roles were discussed in Chapter 5.

   C-Print text: *We are talking about those personal factors such as my perception of roles in the family, discussed in Chapter 5.*

Summarizing

Summarizing means condensing information to its important points or core meaning. Small amounts of information can be summarized by reducing the number of words in a sentence. Larger amounts of information may be summarized, too. In this case, the operator may capture important points, but not every point in every sentence.

1. Summarize when the speaking rate is too fast to capture verbatim. When the speaker is speaking too fast to capture verbatim, leave out extraneous details and type shorter sentences.
2. Summarize larger amounts of information when information is coming at an extremely fast rate or is presented in a dense manner. This type of summarizing

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requires good listening and comprehension skills. Four principles are employed when summarizing large amounts of information: (a) type the main ideas, (b) type the topic sentences, (c) select the important, essential ideas, and (d) replace individual examples with the more general idea.

Chapter IV

The C-Print Captionist

Lisa Elliot, Barbara McKee, Michael Stinson,

Vicki Everhart, Pam Giles-Francis, and Gina Coyne

In this chapter we discuss the roles and responsibilities of the C-Print captionist, the training of captionists, captionists' performance during training, and in the classroom, and captionists' impressions of their jobs as revealed through interviews.

Roles and Responsibilities

The C-Print captionist has responsibilities both inside and outside the classroom. The goal of the C-Print captionist is to provide a real-time display and to print a hard copy of the transcribed text to the student. Captionists play a key role in providing communication access for students through the C-Print real-time display and by helping the students to participate in class and to learn course content. For the service to be successful, the captionist must work with students, teachers, and other support service personnel as part of an educational team. The various roles and responsibilities that captionists need to assume to achieve this goal are described below.

Classroom Responsibilities

Prior to actually providing transcription, the C-Print captionist needs to make contact with the students to be served and explain the system, its capabilities and limitations and also to explain the students' responsibilities pertaining to C-Print. For example, students will only receive a hard copy of the notes if they attend class. Also, C-Print transcription is limited to the

oral information presented in class. Students are responsible for notes written on the board or on an overhead.

C-Print captionists also need to establish rapport with the classroom teacher. This involves explaining the system as well as defining the captionist's needs (e.g., instructor should speak clearly and not too quickly). The C-Print captionist may also work with the instructor to obtain the syllabus, reading assignments, or other class materials in advance.

Finally, in preparation for real-time transcription, the captionist is responsible for her equipment. The captionist transports the laptops to and from the classroom. If a TV is being used for the display, the captionist needs to connect it to the laptop. If the students will be using a second laptop to view the display, the captionist needs to connect both laptops to each other. Of course, the captionist is responsible for handling any technical difficulties that may arise during class.

Out of Class Responsibilities

Once class has concluded, the captionist needs to edit the transcript for errors and copy it for students attending class. The transcript needs to be distributed in a timely manner, usually within 24 hours or before the next class meeting.

In addition to preparing the transcript, out of class responsibilities may involve the captionist familiarizing herself with specialized vocabulary, reviewing the text, entering additional abbreviations into the C-Print dictionary, or practicing abbreviations and brief forms.

Following is a list of captionist's responsibilities that was developed for the support service offered at NTID. This information regarding policies for the C-Print service is passed out to students at NTID.

C-Print

Support Service Policy

General Information

- For courses where C-Print is the only assigned service, interpreting and notetaking services will not be provided. If a student wants permanent interpreting or notetaking services, the student will need to transfer to an NTID supported section of the course or take a different course.
- C-Print notes are not a substitute for attending class.
- C-Print notes are not guaranteed to have 100% correct grammar or spelling because the notes need to be edited quickly and distributed as soon as possible.
- C-Print notes are intended to be used by supported student(s) registered in the course and should not be copied unless otherwise specified by the professor.

Captionists' Responsibilities

The C-Print captionist(s) will:

- provide an in-class text display for appropriate support service students. In addition, notes (generated from the text display) will be made available to support students who attended class.
- make every effort to type spoken information word-for-word, and will communicate the information in the manner in which it is intended. At times (during fast speech), the captionist will need to summarize information, but s/he will type as much of the important information as possible.
- assist by voicing comments or questions typed by the student(s) on the laptop provided, or in a way mutually agreed upon.
- begin typing upon the arrival of the student(s). Any announcements made by the teacher before the student(s) arrive will be typed. After 10 minutes, if none of the supported students are in attendance, the captionist will leave. However, if the student has notified the C-Print Office or the professor at least 24 hours in advance, the operator will take notes if approved by the professor.
- indicate different speakers in the text by using "Professor", "Female Student", and "Male Student."
- be responsible for facilitating communication between the supported student(s) and others (e.g., the professor and other students). This includes asking for clarification from the professor or other students when necessary and sitting in an area accessible and convenient to the student(s).
- be responsible for trying to resolve any problems stemming from student or professor concerns about C-Print.

- arrive at least 10 minutes before class to allow time for equipment setup.
- be familiar with the scheduled lecture by preparing for class through reviewing the textbook and related materials.
- find a replacement if s/he is sick. If a replacement cannot be found, the captionist will notify the appropriate support department who will notify the supported student(s).
- provide on-the-spot trouble shooting for equipment breakdown with minimum disruption to the class. If no solution is found, the captionist will make every effort to accommodate the supported student(s) to the best of her/his ability. Technical breakdowns are unforeseen and most often require a diagnosis outside the classroom environment.
- when necessary, request an interpreter for special circumstances such as an oral presentation by the supported student(s).
- provide class handouts to individuals who receive notes that were not in class (e.g., the tutor).
- summarize videotapes (captioned or uncaptioned).

Supported Student(s) Responsibilities

The student(s) will:

- introduce themselves to the captionist so s/he is familiar with each student.
- be responsible for taking notes and diagrams from the blackboard or overheads.
- be responsible for notifying the C-Print Office if h/she will not be attending class or has dropped (withdrawn from) the course. Three consecutive unexcused absences will result in the termination of C-Print services.
- inform the C-Print captionist if s/he is having difficulties with text display or notes. In addition, it will be helpful if the student(s) identifies any suggestions s/he has for improving the use of C-Print for her/his needs.
- be responsible for double-checking spelling on any vocabulary.
- raise her/his hand when interested in communicating comments or questions through typing on the laptop provided.
- inform the captionist of any special needs (e.g., interpreter for special circumstances) at least two weeks in advance.

Training of Captionists

Initially, work on the materials for training C-Print captionists focused on revising materials that had been developed prior to the Office of Education's support of this project.

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Those initial materials were developed to cover a six week training session. The phonetic rules were organized sequentially and an average of two new rules were presented in each lesson. Those early materials have been revised several times over the past three years and major modifications have been made to the content and format. What has remained consistent, however, is the fact that training and the accompanying training materials are an iterative process. Each time a group goes through training, we have made improvements to our methods and materials.

The remainder of this section will briefly discuss the work that was completed on the materials during each of the three grant years, will describe the current training materials, will review the training "outcomes" (captionist speed and accuracy) and briefly review our future plans related to training materials.

Training and Training Materials - Year One (December 1, 1993 to November 30, 1994)

At the beginning of the first year of the grant period, materials developed from earlier work on the system were refined and used to train our first full time captionist. That captionist, who would later become our training coordinator, learned the system and piloted the system for the first time during the fall quarter of the 1994-95 academic year (September to November, 1994). During the fall of 1994, a second (part-time) C-Print captionist was hired and trained by our first captionist. A great deal of information was gathered during this first year, and the project team made some major decisions. It was decided that our original goal of "verbatim" capturing of lectures was simply not realistic given the other constraints that we had placed upon the system. In order to capture verbatim a lecture given at 120 words per minute (slow normal), the abbreviation rules would have to enable the captionist to drop fifty percent of his/her keystrokes. Although the staff realized that such a reduction in keystrokes was not feasible for a

significant portion of a typical college lecture, we anticipated that there would be a large number of often repeated phrases or sentences in most lectures.

This was a major turning point for the training portion of the project. We realized we would need to add a text condensing/summarization component to the training and simplify the abbreviation rules because of the additional cognitive load placed on the captionists by summarizing the information presented in the classroom. Near the end of year one (fall, 1994), we brought in a consultant from Productivity Plus, the software company that developed the abbreviation software and discussed in some depth, methods of simplifying the abbreviation rules.

Training and Training Materials - Year Two (December 1, 1994 to November 30, 1995)

During year two of the grant, major modifications were made to the training materials. The original twenty abbreviation rules were reorganized into five principles and some of the more difficult rules were dropped. A section on condensing/summarizing was added and the amount of audio tape practice was more than doubled. A complete description of the current training materials can be found later in this section. Also during year two, a second part-time captionist was hired and trained. The captionist hired during the fall of 1994 worked in the classroom during the winter and spring of 1995 under the mentorship of our training coordinator. Between the two people, we piloted the C-Print system in 10 courses from December of 1994 through November of 1995.

Training and Training Materials - Year Three (December 1, 1995 to November 30, 1996)

During this final year of the grant period, final revisions to the materials were completed in anticipation of a summer training workshop that would accommodate up to 10 people. The second part-time captionist was trained and began her classroom apprenticeship training. During the summer of 1996 eight people were trained to become C-Print captionists. The trainees were

from across the country (two from California, two from New Mexico, one from Ohio, one from Pennsylvania, one from Oklahoma and one from Arkansas). Data from the summer workshop is reported below. Results indicated that the two-week training period allowed the participants to learn the basics of both the abbreviation rules and the condensing strategies. The trainees will now have to practice with the system in order to bring their speed up to acceptable standards.

Description of Training Materials

The current training materials consist of a manual comprised of twenty individual lectures and approximately 50 audiotapes that accompany the lessons. The lessons are arranged as follows:

Lessons 1-5	C-Print abbreviation principles 1, 2, and 3. Some "Brief Forms" and practice. *Brief forms are abbreviations that do not follow the abbreviation rules. Many are commonly used abbreviations such as those used for the names of states and countries.*
Lessons 6-10	C-Print abbreviation principles 4 and 5. More "Brief Forms" and more practice.
Lessons 11-14	Remainder of "Brief Forms" and **lots** of practice with abbreviation rules.
Lessons 15-17	Guidelines and practice with condensing (summarizing) what you hear.
Lessons 18-19	Practice with real-time recorded lectures.
Lesson 20	Editing existing C-Print dictionaries and creating new dictionaries.

Each of the lessons include at least two audiotapes that enable the captionist to practice the particular rule or brief form presented in that lesson. Additionally, some of the lessons include more than two audiotapes. For example, Lessons 18 and 19 include approximately five hours each of actual classroom lecture to help the trainee become used to typing and condensing actual classroom material. Complete sample lessons can be found in the appendix, but a brief portion of Lesson 2 and Lesson 15 are reproduced here.

Excerpt from Lesson 2

The second principle will take a little more thinking. As you begin learning the rules for deciding what abbreviation to type when you hear a word, remember that the rules are generally based on how a word ***SOUNDS****, NOT how it is* ***SPELLED****. You should concentrate on hearing the sounds of a word rather than thinking of how it is spelled. Several times in the next few lessons, the text will refer to SOUNDS and LETTERS. Sounds are what you hear and letters are what is written. This difference will be important to keep straight as you learn the abbreviation system.*

Principle 2 ***Type only the sounds you hear in a word. Do not type letters that are silent.***

type letter/symbol abbreviation	*for sound*	*example*	
k	*k*	*clean, kitchen*	*klen, kcn*
s	*s*	*source, service*	*sors, srvs*
c	*ch*	*children*	*cldrn*
j	*j*	*general, justice*	*jnrl, jsts*

This section continues in actual training manual

Excerpt from Lesson 15

In Lessons one through fourteen you were learning and practicing with the C-Print abbreviation system, which we hope allows you to reduce the number of keystrokes needed to produce many words and hence type faster than your normal speed. However, we realize that even if you used the abbreviation system in an optimal manner, you still would not be able to keep up with most college lectures. Therefore, the next group of lessons will give you some guidelines and tips on "condensing" or summarizing lectures.

It is important for you to realize that the remainder of the C-Print lessons are different from the first lessons. While you were learning the abbreviation system, there was a "correct" way to do things. By that, we mean there was only one correct abbreviation for a given word. You could type the word out completely and not use the abbreviation for the word, but if you did use the abbreviation, it was either right or wrong. Summarizing or condensing information is different because there is not one "correct way." The goal is to include as much of the important information as possible, but the exact words you use are up to you. Over the next few lessons, we will be giving you guidelines that will help you, but you must apply the guidelines in a manner that fits you.

Similarly, it is now more difficult to judge your progress, since we can no longer simply look at your speed and the amount of typing or abbreviation errors. The next three lessons all have the following format.

1. You will be given some guidelines and suggestions related to condensing information.
2. The lesson tape will give you a few brief exercises to let you practice those guidelines. Lesson tapes 15 through 17 will ask you to listen to and summarize some "mini-lectures" of 10 to 12 minutes each. The "mini-lectures" will be read at 80 words per minute for lesson 15 and increase to 110 words per minute by lesson 17. Because lesson 15 focuses on "active listening," you will not be asked to summarize a lecture, only to listen and answer questions about what you heard.

This section continues in actual manual.

Training Outcomes and Captionists' In-Class Performance

Our captionist training during the three years of the grant has generally followed two models, an apprenticeship model and an intensive workshop model. Our first three captionists were hired and trained individually under what could best be described as an "apprenticeship model." The first captionist, and the only one who completed training using the materials developed prior to the grant, was hired full time and trained over a six month period. She had other project responsibilities and worked with the training materials approximately 10 hours a week. Her primary instructor was the linguist who developed the original abbreviation rules. That person is now our coordinator of training and is still working full-time for the C-Print project. The next two captionists hired, one in the fall of 1994 and one in the spring of 1995, trained over six-week periods. Neither of them had other project responsibilities and they worked on the training materials approximately 20 hours a week. Both of the part-time people had the support of their trainer when they entered the classroom for the first time; in other words, the trainer was in the class with them and could take over if the partially trained captionists became fatigued or could not keep up with the lecture.

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Assessments of Training

Assessments of these first three captionists was informal and infrequent. Table 1 below summarizes the information that was collected.

Table 1
Testing Information from First Three Captionist
Trained Under Apprenticeship Model

	Captionist		
	A	B	C
Pre-Training			
Typing Speed	60.4	58.2	62.4
Post-Training			
Typing Speed with abbreviation system		56.4	71.6
Typing Speed without abbreviation system		63.6	67.8
End of First Quarter			
Typing Speed with abbreviation system	77	60.7	77.6
Percent of Information Captured by Operator During Actual College Lecture*			
Lecture One			
Important Information	79%	71%	91%
All Information	63%	51%	75%
Lecture Two			
Important Information	91%	90%	75%
All Information	72%	61%	66%

*See accompanying narrative for explanation of methodology.

Limited information was collected for the first three captionists. As is shown in Table 1 data were collected at four times. Table 1 summarizes the information that was collected. Standard sets of materials were used. The typing test, or first set, was in the form of a letter, and the other three were three minute dictations of a standard set of lecture materials.

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Captionists' In-Class Performance

The most important information is presented in the bottom half of Table 1, which is the percentage of information captured during an actual college lecture. The procedure for collecting these data compared the text produced by the captionist with that of a speaker, such as a teacher. Segments of approximately 750 words for each of six lectures delivered in classes at RIT were each divided into idea units. These segments were approximately 8 minute portions of 50-110 minute lectures. Idea units were defined as a clause or sentence containing an active or status verb (Mayer, 1985; Thorndyke, 1977). These six lecture segments, with the idea units indicated (range 69 to 115 units), were then distributed to 13 hearing college students who independently rated the importance of the idea units. Interrater agreement ranged from .75 to .86 for the intraclass correlation coefficient. The one-third of the units more frequently identified as "more important" were designated as the units with the more important ideas.

In determining the extent of agreement between the captionist's and lecturer's text, a coding approach was adapted from the work of Mayer (1985). He suggested that corresponding units be evaluated on the extent they have the same main predicate, the same key subjects and objects, and they capture the same meaning. We developed a coding system that considered the fact that captionists cannot type the lecture verbatim, and must summarize the information presented. Two coders working independently read the text of the original spoken lecture segment and the text typed by the captionist. For each idea unit in the original lecture, the coder determined whether or not the captionist's text included the same idea in terms of meaning equivalence. Ideas were credited as having meaning equivalence when there was full equivalence, when it was largely equivalent, or when the idea was recently captured in the captionist's text. Frequently ideas that were largely equivalent were those that summarized what the lecturer said. An example of a unit that was coded as largely equivalent was, "He screamed

and yelled," for "He screamed and ranted and pounded, particularly at the beginning." Captionists were given credit for a repeat if the lecturer repeated an idea that the captionist had already recorded. In this case the captionist did not record it again within a segment of the original lecture equivalent to 20 lines of the typed original text (generally equivalent to a "paragraph"). Units produced by the captionist were scored as not equivalent in meaning if the idea was missing or if the meaning was different from that in the original lecture. Cohen's Kappa (Bakeman & Gottman, 1986) was used to compute the extent of agreement between the two judges. Kappa ranged from .65 to .80 for the six lectures, with an average of .78, which is a good level of reliability for this index.

The results in Table 1 show that for the six lectures captionists captured a greater percentage of important idea units (mean percent=.83) than of all units (mean percent=.65). An examination of the idea units that were scored as not equivalent in meaning indicated that these typically were units that the captionist omitted rather than the units that had erroneous information.

Training of C-Print Captionists for Other Sites

The second model of training was carried out during the third year of the grant period. During July of 1996, a workshop was conducted for 8 potential captionists from across the country. The workshop was very intensive. The attendees spent approximately six hours a day with the training materials and another 2 to 3 hours a day in practice or in discussion sessions related to implementing the system in different environments. The following first week schedule of workshop activities illustrates the intensity of that schedule.

WORKSHOP SCHEDULE

Day	A.M. 9:00 - Noon	P.M. 1:00 - 4:00	Eve 6:00 - 8:00 7:00 - 9:00
1 Monday	Set-up and Lesson 1 Overview and Practice typing from audio	Lesson 2 Principles 1 & 2 (don't abbr. words of four or less letters and type what you hear)	Info./rap session with whole C-Print team (including Barb and Joyce, if possible)
2 Tuesday	Lesson 3 All Practice (plus brief forms) Most lessons have brief forms	Lesson 4 (Vowel Rules)	Practice On Your Own
3 Wednesday	Lesson 5 All Practice	Lesson 6 Suffixes	Types of Deaf Hard of Hearing people Lecture by Mike
4 Thursday	Lesson 7 All Practice	Lesson 8 Review	Night Out (Movie/Play - See what's happening in town)
5 Friday	Lesson 9 Prefixes	Lesson 10 All Practice	Practice On Your Own

More complete information was collected on the Summer 1996 workshop participants. Table 2 summarizes the quantitative information related to speed and accuracy for those participants and Tables 3 and 4 summarize the participants' perceptions of the workshop. Prior to beginning training, the participants were given three "pre-training" tests, a typing test, a phonetic test and an English test. The trainees' incoming typing speed varied a great deal from 35 to 90 words per minute. This was expected since our participants included college support staff who typed little to professional secretaries. Participants were also given a phonetic test developed by the C-Print staff. The test assesses the captionists' ability to "hear" the sounds in a word regardless of the spelling (e.g. coffee=kawfe, music=muzik, neighbor=nabor, etc.) As can be seen in Table 2, all the workshop participants correctly identified more than half of these "sound spellings" and most obtained scores about 66% correct. This ability to "hear" how a

word is pronounced regardless of the spelling is an important prerequisite skill for a captionist. The skill appears to be one of those "necessary but not sufficient" characteristics. Higher levels of the skill do not seem to correlate with later success as a captionist, yet without the skill, success as a captionist is almost an impossible task. We have yet to determine a cut-off on this test for success as a captionist however, scores below 50 percent appear to be a cause for concern.

Finally, the workshop participants were given an English test taken from materials used to prepare students for the Graduate Record Exam. We later determined that this test was probably too difficult for our needs and cause frustration on the part of the participants. Although a minimum level of English skills are require to function successfully as a captionist, we have since replaced the test with an easier version. English skills, like auditory phonetic skills, are necessary for success as a captionist and yet higher levels of the skills do not necessarily translate to greater success as a captionist. We have found it necessary to continue use of the tests to screen out applicants with low levels of the prerequisite skills (typing, auditory phonetics, and English).

At the end of the two week training period, participants were asked to type two passages. Each passage contained over a hundred words that were in the C-Print dictionary and hence, could be abbreviated. The passages were read at a "slow normal" rate of approximately 120 words per minute and the participants were instructed to capture as much of the passage as possible. They were also instructed to use as many abbreviations as possible but, if necessary, sacrifice use of the abbreviation system to capturing the information through condensing and summarizing. The passages were scored in several different ways. First, the number of abbreviations attempted by the participants were counted (the actual keystrokes entered was saved, so we could determine what the participant actually typed) and the number of those

abbreviations that were correct were noted as shown in Table 2. This allowed us to determine the percent of correct abbreviations out of the number attempted. At this point we were only interested in the number correct out of those attempted, since we had instructed the participants to sacrifice the abbreviations for summary and condensing when necessary.

We then divided each passage into general idea units (12 in passage 1, twenty in passage 2) and scored the participants' transcripts in two ways. First, we simply counted the number of idea units that were included in each passage even if in a condensed version and second, we gave the passage an overall global rating of the completeness and comprehensibility if the passage. Each transcript was rated by two raters and any differences were discussed and an agreed upon global rating was assigned. The results of these scorings are also presented in Table 2. Participants did better on the first (slightly shorter) passage with all receiving overall scores of 4 or 5 and most including two-thirds or more of the idea units. On the second passage, the overall scores ranged from 3 to 5 and four of the seven participants captured less than two-thirds of the idea units.

Tables 3 and 4 present the participants' perceptions of the workshop. As is clear from these two tables, generally, this workshop was received positively by all those who participated.

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Table 2
Pre and Post Training Test Scores
C-Print Training Workshop - Summer 1996

Trainee	Pre-training Information			Post-training Information											
				Abbreviation Use						Information Captured					
				Passage 1			Passage 2			Passage 1			Passage 2		
	Typing Speed (wpm)	Phonetics Test (% correct)	English Test (% correct)	Abb. Att.[1]	Abb. Cor.		Abb. Att.	Abb. Cor.		Global Rating[3]	Percent Idea Units		Global Rating	Percent Idea Units	
					N	%		N	%	N	N	%	N	N	%
A	47	62.6%	51.4%	58	36	(62%)	52	25	(48%)	4	10	(83%)	4	10	(50%)
B	61	66.7%	28.6%	47	38	(81%)	34	23	(68%)	5	10	(83%)	5	15	(75%)
C	35	77.3%	68.6%	33	21	(63%)	41	15	(35%)	4	8	(88%)	3	8	(40%)
D	41	77.3%	68.6%												
E	90	73.3%	54.3%	29	20	(69%)	19	8	(42%)	5	9	(75%)	4	9	(75%)
F	48	52.0%	60.0%	37	29	(78%)	29	25	(86%)	4	8	(66%)	3	11	(55%)
G	66	89.3%	25.7%	55	23	(42%)	53	22	(42%)	4	8	(66%)	4	12	(60%)
H	65	85.3%	51.4%	76	62	(82%)	68	46	(68%)	5	12	(100%)	5	16	(80%)

1. Total number of abbreviations attempted (approx .110)
2. Number of abbreviations correct and percent correct, out of number attempted
3. Overall global rating of completeness and comprehensibility of passage (5=complete and comprehensible, 1 = minimally complete and comprehensible
4. Percent of total idea units in passage included in transcript
5. Data not available

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Table 3
Participants' Ratings of Summer 1996
C-Print Training Workshop

Item	Percent Choosing Response Option*				
	SA	A	NS	D	SD
1. Workshop can be applied to my work.	88%	25%	—	—	—
2. I learned skills in this workshop that are needed by people in my field.	75%	13%	13%	—	—
3. I enjoyed this workshop.	75%	25%	—	—	—
4. The level of this workshop was too advanced.	13%	—	13%	38%	38%
5. The length of this workshop was about right for the content presented.	25%	50%	13%	13%	—
6. The faculty willing clarified things for me when asked.	100%	—	—	—	—
7. The faculty were approachable and made me feel comfortable.	100%	—	—	—	—
8. The faculty explained new concepts and ideas clearly.	100%	—	—	—	—
9. The faculty was interested and enthusiastic.	100%	—	—	—	—
10. The handouts and Other printed materials were helpful.	100%	—	—	—	—
11. I would recommended this workshop to a friend/co-worker.	100%	—	—	—	—
12. I would like to take another workshop from these instructors.	100%	—	—	—	—
13. The arrangements/planning for the workshop were good (meals, hotel, etc.)	100%	—	—	—	—

*Response options
5 = Strongly Agree
4 = Agree
3 = Not Sure
2 = Disagree
1 = Strongly Disagree

Table 4
Participants' Ratings of Summer 1996 - C-Print Training Workshop
Open-Ended Items

Questions and Verbatim Participant Comments

What did you like best about workshop?

- The enthusiasm and professionalism of the staff
- A number of things: (1) The staff was fantastic! They kept us going and interested in the material; (2) its potential for application to my department; (3) The materials were well organized & clear.
- It was laid back, not a lot of stress or pressure related to the workshop itself (away from home issues different kind of pressure and stress).
- The staff was very friendly and helpful. The material was presented very well.
- The way the staff took care of our needs so that I could concentrate on learning C-Print.
- Because training was intense and people had to be away from home and families for 2 weeks, I liked how they (faculty) were so considerate and understanding. I like the C-Print concept and look forward to the benefits from this new skill I have learned. Also the reassurance Pam kept giving everyone.
- The fact that it introduced a new tool that I may utilize to enhance skills in my present position, and increases the possibility to further extend my potential
- Coming and seeing the sights in New York. Have never traveled away from home before.

What did you not like about this workshop?

- There wasn't anything that I did not like.
- Staying away from home.
- Being away from home for so long. The idea of "test" even though I knew it was not for a grade but for statistics, it is still intimidating.
- The necessity of being away from home for 2 weeks.
- The most difficult thing for myself, was being away from home for 2 weeks.
- Sometimes it was too slow, waiting for people to catch up.
- Really nothing was disagreeable.
- Not enough down time to digest and work with course materials.

Please list your suggestions, comments, or recommendations for improvement of this workshop:

- More time to practice
- Require people to have certain computer skills as part of the pre-testing procedure.
- None
- The workshop was well done. I believe that regional workshops will be easier to attend.
- Maybe instead of a test have some practice sessions that can be used maybe three times during the week.
- Instead of a "test" at the end, give a little one each day to lessen anxiety of just one big one.

What additional areas of training or what other kinds of workshops would be useful to you?

- Continued practice and possibly on hands training
- Do not know at this time.
- Maybe the audio typing and phonetic training
- For myself (interpreter workshops), but in this area, it would be nice to have a follow-up workshop.
- Workshops on retaining information in short term memory.
- Computer training

Do you have any additional comments? What did we forget to ask you?

- I can't think of anything - Thanks for all your hard work!
- Will e-mail if anything comes up.
- I had a wonderful time and feel that I am learning a valuable skill.
- I thought it was long. I feel the workshop was very successful.
- Thanks for everything. I will miss you and will not forget you or this experience!
- I appreciate the experience I was given, and am grateful for the hospitality.
- This was fun and I feel fortunate to have participated in G-Print. Good luck with your research grant. I truly believe this can be successful.

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Chapter V

C-Print Captionists' Perceptions of Their Job

Lisa Elliot and Michael Stinson

An important part of the project was to describe the C-Print captionists' experiences on the job—that is, how they perceived and understood what they did and how they felt about these experiences. There was a need for information regarding difficulties the captionists experienced, such as potential fatigue in typing under real-time conditions, on procedures that facilitate more efficient operation, such as a system for distribution of printouts after class; and on interactions of the captionist with deaf students, support staff, and faculty. In this section, we summarize the perceptions of the C-Print captionists that they conveyed in interviews.

Three C-Print captionists were interviewed about their experiences using C-Print. One of the captionists was interviewed three times; after two weeks of using C-Print for transcribed notes only, 2 months later (after having used a second laptop computer display for three weeks), and three months later. The second captionist was interviewed after her first quarter in the classroom (10 weeks); the third captionist was halfway through her first quarter as a captionist. In total, five interviews were used in this analysis.

Topics to be covered in this summary include: class preparation; real-time experiences and on-the-job stress; preferred characteristics of professors; enjoyment of C-Print activities; and, C-Print notes' utility and distribution. Captionists were also queried about training issues, but those comments will be reserved for an analysis of the captionist training program.

Class Preparation

The C-Print captionist's job begins long before the bell rings. One captionist commented that she would spend "up to an hour preparing for each class." Captionists prepare for class in a

number of different ways including reviewing handouts or overheads to be distributed in class, previewing movies, reading the textbook and learning the vocabulary. One captionist practiced the abbreviations for frequently occurring words.

If the captionist was comfortable with the subject material, she would spend less time preparing for class. While all the captionists tried to prepare for class to some extent and found it important to do so, they were also frustrated by those professors who did not follow the text or who did not follow their own syllabus.

C-Print Captionists in Action: Real-time Experiences

The real-time experience, as captured by the captionist interviews, encompasses several features. First, there is the transcription experience itself—the ability to listen and capture the lecture or discussion as near-verbatim as possible. A second component of the real-time experience is the C-Print display with either a second laptop or a TV monitor. Third, the ergonomic aspect of transcription needs consideration. Finally, captionists commented on the applicability of C-Print technology in different teaching environments.

Transcription

> *Real-time transcription requires one to trust oneself...trust that you'll actually be able to capture all (or most) of the incoming info.*

The biggest challenge for the C-Print captionist is to be able to actively listen and transcribe as close to verbatim as possible. Of course it is not always possible, or practical, to do this. For example, all the captionists agree that there are times when they delete information. In particular, deleted information tends to be repeated information, material that is irrelevant to the topic, or repeated examples of a point.

The captionist may also attempt to clarify the professor's lecture by modifying the language or adding additional words to complete a thought. For example:

I also sometimes will try to use more elementary language than what is being spoken by the professor. For example, I may change "coercion" to "force." From sign language class, I've learned that deaf people often have difficulty with the vocabulary and grammar of English, so I will tailor the lecture for a person whose native language is not English. Also "force" is faster to type than "coercion."

One of the advantages of the C-Print system is the specialized dictionary that can be created for a course. Captionists found the specialized dictionary very useful in their transcribing experience:

The specialized dictionary I created for that course was very appropriate and helpful. I used it most often toward the end of the quarter.

C-Print Display

An issue during C-Print real-time captioning is the ability for students to watch the display, and its psychological effect. One captionist acknowledged that being observed influences her typing style. She was much more conscious of errors and trying to change them. She felt that this situation was frustrating because she knew she could do a better job.

Ergonomic Issues

The physical environment in which the C-Print captionist works can have long-term implications with regard to musculoskeletal conditions, and so there is concern with the physical experience of transcribing for the captionist and its long term impact. It is also a tiring activity. According to one captionist:

This kind of work is VERY fatiguing. Feels like it is "do or die." There's no in-between.

Major ergonomics factors for the captionists include working at an appropriate chair and table. These are not always available in the classes C-Print serves. Temporary solutions that captionists have considered include bringing cushions for themselves. However, captionists also

realize that making adaptations to their environment requires bringing additional materials with them to class—something that they are less than enthusiastic about doing.

Lecture vs. Discussion Formats

C-Print seems better-suited at this time to lecture-based classes. When C-Print captionists find themselves serving classes which involve discussion at the class or small group level, their job is more difficult.

> *Interviewer: This quarter, you are also in a class where there is mostly discussion. How are you handling that?*
>
> *Captionist: Initially, not very well. I lose what the professor says sometimes because I have to stop and concentrate so hard on what the student(s) just said. It is sometimes very difficult to hear the students and also hard to figure out what their point is. Many students do not articulate their point very well.*
>
> *Because it is so difficult to transcribe what the students' points are, I will sometimes miss the next student's comments or the professor's next comment. Toward the end of the quarter, I was focusing more on what the professor said and less on the students' comments.*
>
> *Toward the end of the quarter, I was focusing more on what the professor said and less on the students' comments*

This captionist also had some suggestions for students and the professor to make transcribing easier in discussion situations.:

> *This It needed to be made clear to the small group (that I transcribed for) that I need to understand what they are saying. This quarter, I felt uncomfortable interrupting them to ask them to repeat their comments.*
>
> *In the group/classroom discussion, it is hard to switch to many new voices after having gotten used to one or a few voices. Also it's hard to make sense of some of the student's comments and type them in a way that makes sense (comprehensible). It would be helpful if the instructor reiterated the students' points.*

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On-the-Job Stress

The challenges of real-time transcription are many, as described in the section above. Sometimes these challenges were perceived more urgently as stressors. The predominant stressors relating to the C-Print captionist's job can be classified into four general categories: technological stressors; classroom surprises; capturing information; and, post-class production.

Technological Stressors

Two topics were raised by captionists that relate to technological stressors. The first stressful situation occurs when the class before the C-Print class is dismissed late and the captionist has to rush to set up the equipment. The second stressor concerns equipment malfunction. One captionist described her experiences this way:

> *One time the computer started bolding in the middle of class and I lost lots of information trying to fix that problem. One time Barb was typing and the second laptop started incessantly beeping. Those things are extremely frustrating.*

Classroom Surprises

Classroom surprises are those events for which the C-Print captionist cannot prepare. For example, professors might present material not listed in the syllabus. Since class preparation is considered very important by the captionists, they find it frustrating to be caught unprepared. Other unexpected events may include videos, group presentations, or new voices speaking during discussions.

Capturing Information

By far, the largest source of frustration stems from not being able to capture information according to the C-Print captionist's own high standards. Captionists may miss information because the lecture or discussion is too fast-paced:

> *...and then the professor started going faster toward the end of the quarter. He was cramming more information in; the pace speeded up...*

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Captionists may also have difficulty if they cannot hear what's being said or if the professor's presentation is unclear in its meaning.

It is also important for the captionist to be familiar with the terminology and appropriate abbreviations. The specialized dictionary may be useful in those situations:

> *If, for example in Financial Accounting, the professor uses long words or phrases in a class over and over, but I've had no opportunity to add them to the specialized dictionary; that is very frustrating.*

Finally, the C-Print captionist has difficulty dealing with visual information presented on chalk boards or overheads because the system is not currently set up to handle this kind of information. One captionist illustrated the situation this way:

> *There are lots of numbers, lots of equations, lots of terminology. It is not exactly clear how is best to capture the numbers and equations yet. We don't attempt to copy what is on board or overhead, but it is difficult to correlate his speaking with the information on the board or chart on the overhead. For example, he may say, "This number (pointing) goes with that (pointing at different number)." It's difficult to capture the important meaning in that situation.*

Post-Class Production

The final category of on-the-job stress concerns producing and distributing the C-Print notes for the students. One captionist found it difficult to "find the time to edit the notes and get them out to the students on time." This task was particularly challenging when the class met on a Monday-Wednesday-Friday schedule.

Stress Reduction

Stress reduction was not covered in every interview. However, one captionist was asked to discuss her means of stress reduction with regard to the job. Her suggestions included:

- Exercise between classes,
- No caffeine (or anything else that increases adrenaline levels) before class, and
- Be confident in what you're doing because no one else can do what you can.

Preferred Characteristics of a Professor

Captionists were asked to describe professors' characteristics or behaviors that worked well with the C-Print service. Two major categories of attributes were raised by the captionists, attitudes and behaviors.

Attitudes

A positive attitude on the professor's behalf may be expressed in several ways. The professor should be accepting of the service and help the captionist accomplish her goals. Ideally, the professor will also welcome the captionist into the class and inform the students about why the captionist is present. As stated by one captionist:

> *Acceptance by the professor is VERY important. Is important to be included in class...not stuck off to one side, but rather professor stating why captionist is there. Important to have professor tell class that C-Print is an important service. Having a professor who is receptive to the idea of C-Print really helps.*

Behaviors

C-Print captionists found several behaviors indicative of a good working relationship with professors. Professors who are committed to C-Print give captionists class materials ahead of time and inform captionists about what will happen in class. These professors also speak slowly and clearly so that the captionist hears them and makes sure that the captionist hears students' comments as well.

Enjoyment of the C-Print Job

C-Print captionists were asked whether they enjoyed their work in the classroom. Their response was very positive. The only negative comments expressed were issues largely beyond the captionists' control such as having an acoustically perfect classroom and having better weather in which to transport equipment across campus. Positive aspects of the job may be divided into extrinsic and intrinsic factors of job satisfaction.

Extrinsic Factors

Captionists mentioned three specific aspects related to this job that could be considered extrinsic, or qualities shared by other jobs. Captionists mentioned good benefits, in particular, having the opportunity to take sign language classes. Good hours was another positive aspect of the job. One captionist even commented that she enjoyed the typing itself.

Intrinsic Factors

Captionists also mentioned aspects of their work which were inherent to the job of a C-Print captionist. For example, the captionists enjoyed working with the students and receiving positive feedback. They found it gratifying to know that the C-Print service was helpful.

Captionists also enjoyed the challenge of the job and the topics covered in the courses. In general, the captionists enjoyed the academic environment and the opportunity to participate in an exciting research project.

C-Print Notes

C-Print captionists also discussed the notes they produced. In particular, they discussed their utility and distribution. One captionist commented on the usefulness of C-Print notes that are based on class or small group discussions. She felt that they were not "helpful as a study tool" because discussions were often diffuse and the topic was not well-identified.

Note distribution was another area that received criticism. Captionists did not like distributing paper copies of the notes. However, distribution through the electronic mail system was not successful either because the files did not always transfer correctly or because the students had trouble reading the files that were sent.

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Conclusion

The C-Print captionist's job, as characterized by these five interviews is challenging, rewarding, and sometimes stressful. Captionists are "on duty" before, during, and after the class session. Class preparation can take many different approaches depending upon the class, the professor's style, and the captionist's familiarity with the subject material.

The real-time experience involves a variety of different skills including accurate typing, active listening and good English skills. The captionist also needs to be confident in her skills so that she is not rattled by students observing the C-Print display. She also needs a flexible attitude (and body!) in order to adapt C-Print to the available classroom furniture. In addition, the C-Print captionist needs to feel comfortable with the professor and students so that she can make necessary requests, such as asking students to speak up or having professors speak slowly and clearly in a variety of lecture or discussion situations.

Some stress accompanies the transcribing task. For example, unexpected mechanical crises such as a quick set-up or equipment malfunction can fluster the captionist. Other classroom surprises such as unanticipated lecture material or a group discussion or video may add new demands. Captionists confront the challenges of hearing the presentation and incorporating new vocabulary on a regular basis. Another significant task is the issue of integrating visual material (i.e., board or overhead displays) into the transcript. Furthermore, editing and distributing the notes in a timely fashion is sometimes demanding. Despite these challenges, captionists are aware of strategies that can reduce the stresses associated with transcription.

C-Print captionists cannot do their job in a vacuum. Consequently, professors with supportive attitudes and behaviors make the captionist's job easier and more pleasant.

Job satisfaction was expressed by all the captionists. Working in the stimulating classroom environment and knowledge that they were providing a useful service were two of the reasons for job satisfaction most often expressed by the captionists.

Finally, the captionists reflected on the utility of C-Print notes in various learning circumstances and the technical difficulties involved in distributing the notes. It is apparent that there are still a few bugs to be worked out concerning when C-Print notes are appropriate and useful. Distribution issues deserve further exploration, too.

The C-Print captionists interviewed were thoughtful and perceptive. These interviews can help guide the development of the C-Print system. The captionists' observations will be a useful guide for future changes.

Chapter VI

College Students' Perceptions of C-Print

Lisa Elliot, Michael Stinson, Vicki Everhart, and Susan Stinson

This section of the final report summarizes a study with college student users of C-Print. Two types of data will be reported: (a) student reactions as indicated by questionnaire responses, and (b) detailed descriptions of how students use the system and their satisfaction with the system, as indicated by responses during in-depth interviews. An additional purpose of this study was to determine whether groups of students with particular communication characteristics were more likely to respond favorably to the C-Print system.

Method

Participants

The participants for this study were 36 deaf or hard of hearing college students (17 females, 19 males) who received the C-Print support service in one of their mainstream courses in the RIT College of Business or Liberal Arts between the spring quarter of 1994 and the fall quarter of 1996. The students provided feedback about the C-Print system through a questionnaire and/or an in-depth interview. This sample was approximately one-half to two-thirds of the students serviced by C-Print during the above time period. Twenty-two of these students participated in the interview study. An estimated 450 hearing students were also in these courses, but were not included in the study.

Demographic information and communication characteristics were available from NTID student records. These data included scores on five tests of communication proficiency, listed here with means and standard deviations: (a) reading comprehension subtest of California

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Achievement test, (M = 10.77, SD = 1.07); (b) Michigan Test of English Proficiency, (M = 81.76, SD = 12.63); (c) speechreading with sound, (M = 68.60, SD = 33.55); (d) speechreading without sound, (M = 46.90, SD = 22.45); and, (e) simultaneous communication reception, (M = 84.00, SD = 14.28). These tests have been administered regularly to incoming students and developed and refined over several years. The reader is referred to Johnson (1976) and Crandall (1978) for information on tests and scoring. Demographic information indicated that virtually all the students in the study came from mainstream programs (n=32) as opposed to separate day or residential schools (n=4). The mean score on a Language Background Questionnaire, which provided a self-rating of sign proficiency, was 2.83 (SD = 1.11), indicating relatively good sign proficiency. The mean pure-tone average for the better ear was 95.12 (SD = 14.32). The overall grade point average of the students was 2.85 (SD = .57).

Courses

For this study, students were drawn from eighteen RIT courses served by C-Print, four business and fourteen liberal arts courses. Examples of courses covered by C-Print were Foundations of Sociology and Social Psychology in Liberal Arts, and Financial Accounting in Business. These courses were taught by four different faculty members in the College of Business and twelve in the College of Liberal Arts. Eight students were served in business courses; 28 were served in liberal arts courses.

Twenty-seven students were served in courses that were more lecture-oriented, five on more discussion-oriented courses, and four in a course that had approximately equal amounts of both lecture and discussion. All students had trained notetakers and tutors were available in their courses, and all but two students had interpreting services as well as C-Print. These two students agreed to use C-Print instead of an interpreter.

Questionnaires

Questionnaire data was collected in order to examine the ease of understanding classroom information using the C-Print system and the perceived usefulness of C-Print relative to more conventional support services offered to mainstreamed deaf students (e.g. interpreting, notetaking). Thirty-six students completed a questionnaire concerning the usefulness, benefits, and preferences related to use of the C-Print system. The number of respondents differed for some of the questionnaire items for various reasons (e.g., two items were added to the questionnaire at a later date, some students did not experience the C-Print display and thus were not asked to respond to items about it).

Three areas involving student perceptions that were of central interest included: (a) use and understanding of real-time display; (b) use and assistance provided by the C-Print hard-copy notes; and, (c) the overall evaluation of the system.

Use and Understanding of the C-Prin: Real-Time Display

Twenty-five students were asked to respond to two items (specifying "interpreter" and "C-Print display: TV or laptop," respectively), written as follows: "How much of the lecture can you understand from watching the (interpreter) (C-Print display)?" The circled percentage for each item (e.g., 0%, 10%, 20%, etc.) provided a subjective estimate of a student's level of understanding.

Thirty-one students were asked: "Often the C-Print captionist has to summarize information. Is that acceptable to you? Do you feel you are getting the important points?" Twenty-six students also responded to the question: "Sometimes there are errors in the C-Print display. How do you feel about them? a.) The errors really don't bother me. b.) The errors that bother me are:_____." In addition, 14 students indicated their preference for the type of C-

Print display they watched during class by circling either "On TV monitor" or "On laptop computer monitor."

Use of and Assistance Provided by the C-Print Hard-Copy Notes

To indicate how much the C-Print notes helped them with their course, all 36 students circled one of f our possible ratings: "Do not help at all," "Help me a little," "Help me enough," and "Help me very much." Seventeen students also circled which they used more: "Notes from a notetaker" or "C-Print notes."

In addition, all 36 students indicated how they used the C-Print notes to study by circling one or more of the following choices: (a) Skim the notes and highlight important information; (b) Make an outline from the information; (c) Note unfamiliar vocabulary & ideas; and (d) Other. To indicate their preference for how the C-Print notes were distributed, 36 students circled either: "Paper copy of notes" or "Notes distributed electronically (through Vax)."

General Evaluation of the System

Students indicated the assistance of the C-Print system as a whole by rating how helpful the system would be "if no interpreter and no notetaker are available." Thirty-six students chose one rating from the following four: "C-Print does not help at all," "C-Print helps a little," "C-Print helps enough," and "C-Print helps very much."

Interviews

The purpose of the in-depth interview was to extend understanding of how students perceived the effectiveness of the C-Print system and how they used it to aid learning in the mainstream classroom. Twenty-two of the deaf and hard of hearing students who received C-Print services in class participated in an in-depth interview. All but one of these students also completed the questionnaire described above.

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Content

Some of the information obtained from the interviews touched on the same issues addressed by the questionnaire. However, the elaborations that students provided, such as exactly how they benefitted from the hard-copy notes, is a unique contribution of the qualitative study. The interviews were open-ended and participants were encouraged to pursue their own line of reasoning.

Procedure

The interviews were conducted in a quiet room with either one or two students. Interviews were 30 minutes to an hour in length. The interviewer began by explaining to the student(s) that the goal was to obtain information that might improve the C-Print system which is being piloted in the classroom. The students were also assured that all their comments would be kept confidential.

The interviews included issues similar to those addressed by the questionnaire items, but permitted more extensive answers that revealed the students' personal perspectives in a richer, more detailed way. A voice interpreter repeated the interviewer's and respondent's sign and voice communication into a tape recorder, and verbatim typed transcripts were generated by the audiotapes.

Analysis

The typed transcripts were first coded into six general categories: (a) real-time display—understanding of lecture; (b) real-time display—other comments; (c) C-Print notes—how used for study; (d) C-Print notes--other considerations; (e) general student characteristics related to using C-Print; and, (f) class setting. The categories were then collapsed into three larger categories corresponding to this study's main topics of interest: (a) use and understanding of the C-Print real-time display; (b) use and assistance provided by the C-Print

hard-copy notes; and, (c) overall evaluation of the system. All the data of the interviews were assigned to one of these two categories by one coder who also prepared a summary of information within each category. Within each category, comments were divided into subtopics.

Results

The results are both quantitative (e.g., the questionnaire data) and qualitative (e.g., the in-depth interview responses) in nature. The quantitative and qualitative information will be discussed around this study's three main topics of interest: (a) use and understanding of the C-Print real-time display; (b) use and assistance provided by the C-Print hard-copy notes; and (c) overall evaluation of the system. Both quantitative and qualitative data are discussed under each main topic, however, only qualitative data is available for a few of the subtopics.

C-Print Real-Time Display

This section of the summary pertains to a variety of issues concerning the students' experience with the C-Print display. For example, how did the student utilize the display, preferences about the look of the display, preferences for TV or laptop display, perception of errors, experiences with videotape and board work, etc.

Exposure to C-Print Display

Students had a variety of exposures to C-print displays on the laptop or TV monitor. For students who completed the questionnaire, 5 out of 36 students viewed the TV display sometimes or most of the time, while 31 students either never viewed the TV or saw it once. At least seven students who were interviewed did not view the TV monitor. Of those students who were interviewed and who saw the TV monitor display, five saw the display approximately 2-3 times. In contrast, the laptop display was viewed more often by students. Sixteen of the questionnaire respondents viewed the laptop display sometimes or most of the time. Among students who were interviewed, seven students saw the laptop display briefly, 5 reported viewing

the laptop display during some class times, and 6 students saw the laptop during every class period. Only 2 interviewed students reported that they did not view the laptop display.

Display mode preferences during class lectures. Of those students who viewed C-Print real-time displays, most preferred the laptop over the TV. Fourteen students responded to this questionnaire item. Ten preferred the laptop, while four chose the TV display. This result must be interpreted with caution, however, since not all students were exposed to both types of the display and the statistical analysis did not reveal a significant difference between the two preferences (chi square (2) = 2.571, p = .109).

According to interview data, students who preferred the TV display felt it was easier to read than the laptop. It was also easier to share the TV display with several students. Nonetheless, more students opted for the laptop and would be willing to share the laptop with another student.

One reason for this preference, as revealed in the interviews, was that it was easier to go between watching the teacher and the laptop monitor, as illustrated by the following quotation:

> *I would say that I would prefer to use the laptop because I would be able to go back if I wanted to. Also, it is easier to move your head from a laptop to a teacher. When you are using a TV monitor, it is more difficult to see them at the same time.*

Another advantage of the laptop is that it provides three or four times more lines of text than does the television monitor; that is, there is substantially more information, as the following interview excerpt indicated:

Interviewer: O.K. I want your opinion of another student's comment. They said, "I prefer the laptop display because there is more information there. More information I can, read, back-up and read if I wanted, compared to the TV." What do you think of that?

Student: I think that he means that on the laptop the words, the sentences are there for a longer period of time than on the TV, because of the spacing. I think it is about the same, but it looks like on the TV, because the words are bigger, they move faster. So it is like maybe 6 or 7 lines on the TV, but on the laptop they have 20 or 30 lines on one screen, so it looks like there is more on the laptop. That is what I think.

Display mode preferences during small group work. While most college courses remain lecture-oriented, professors increasingly solicit students to comment and discussion. In the interview, we asked students their feelings about using C-Print for small group discussion and their preferences for laptop or TV display during group work and discussions.

A small number of students discussed the utility of C-Print in the small group discussion. Of those who spoke about the topic, response was equally divided between those who felt C-Print would be useful in the small group setting and those who did not believe it would be helpful.

Reasons for laptop preferences were similar to reasons given for preferring the laptop display during lecture (e.g., easier viewing, more privacy, etc.). Preferences for the TV display were similar as well. Namely, that it is easier to share with several deaf students. One student also suggested that the TV monitor display could serve as an interpreter for the entire discussion group--deaf and hearing alike.

Use of the Real-Time Display

The majority of students preferred alternating between viewing the display and watching the professor. The following comment describes one student's experience:

To be honest, when the lecture is going on, I go back and forth between the teacher and the TV. But if I understand with the laptop, it is clear. It doesn't mean the interpreter doesn't do a good job but sometimes it is a lot, overwhelming all that information, trying to memorize everything. But if I can look at it on the laptop on C-Print, then I can understand it. Looking back and forth I miss what is happening sometimes actually what is going on with the interpreter. But the information is wonderful on the laptop.

Some students used the display less often. For example, one student used the display only as a back up when she missed something the teacher said. Two other students largely ignored the display because they felt it was easier to participate in class if they didn't have to read C-Print.

Screen elements of display. In the interview students made comments about several elements of the display that could be manipulated. In particular, font size, spacing, screen and letter color. A few students critiqued the font size. While 4 students suggested a larger font for greater readability, 2 students actually thought the font size should be reduced to accommodate more information on the screen.

Spacing and color were two issues frequently raised by the students. Double-spaced display was the overwhelming preference because of viewing ease. Color choice was controversial. Several students opted for dark blue or black backgrounds with yellow or white lettering. However, some students complained that the dark backgrounds were "depressing" or that they were difficult to read from a distance or with the lights off. Clearly, this is an issue which needs to be resolved between the individual student and the C-Print captionist.

Errors in display. Almost all the students noticed an occasional spelling error when viewing the display. However, most students were not concerned. Twenty-two out of 26 questionnaire respondents (chi square (1) = 12.462, $p < .001$) were untroubled by the errors, and the same sentiments were reflected in the interviews. Students recognized that it would be nearly impossible to type so quickly without an error. Students were also questioned about how

the operator should deal with mistakes--whether the captionist should correct the error during the lecture or not. Many students echoed the sentiment that correction was unnecessary:

> *It really doesn't bother me but, what bothers me is if she lost good information, that is what bothers me. If typing and she is going back and ignoring the lecturer and she is worrying about spelling I mean, come on, keep going. Correct it later, you know. You know, keep going. It is all right, it is all right. They do that. They are so worried about corrections and they think that they have to be perfect and it is like no, no, no, there is no time for that. If they did that it would bother me. It is the information that is what is important and that is what they should be getting...*

Lag time of display. C-Print real-time display has a lag time of approximately three seconds. Students were asked in the interview about lag time and its effects. Several students commented that lag time was problematic, particularly in the instance when the professor asked students questions. Several students felt that the lag time of C-Print made it difficult to answer questions because by the time the question was on the display, it had already been answered by some other student. Another student pointed out that it would be difficult to coordinate material presented on the board with the C-Print display because the lag time would cause the written material to be out of sync with the C-Print text.

C-Print display with videotapes. As noted above, utilizing C-Print with visual material is challenging at the current time. Videotapes are often used in college classrooms. Some videos shown in RIT classrooms are captioned, but many are not. One student commented in the interview that having C-Print available during a video is beneficial, since it is sometimes difficult to see the interpreter with the lights off. But, how should the C-Print captionist record information supplied by the videotape?

In the interview students were asked whether they preferred a summary of the video or a verbatim transcription. Students overwhelmingly chose the summary. This student captured the sentiments of many:

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Interviewer: Which way would you prefer the captionist do, word for word or summarize?

Student: I would prefer that she listen and summarize, listen and summarize. If she did word to word, she's going to lose everything. If she just sits there and relaxes, and then types and go (sic) with the flow, type then listen again. Because there is something important in the videotape, the person will stop talking for a while, then she has that time to catch up with everything. Just relax, listen, then summarize.

Other display issues. Other comments included getting a larger monitor screen, concerns about the connecting wires between the laptops, and the limited desk space that exists when the laptop is on the student's desk.

Lecture Comprehension with the C-Print Display

Students were asked how much of the lecture they understood from watching the C-Print display. Students felt that C-Print made it easy to understand the teacher. Sixteen out of 25 questionnaire respondents and 15 out of 22 interviewed students felt that they understood between 90-100% of the lecture with C-Print. According to responses during the in-depth interviews, students felt that they were getting complete information with C-Print and that this facilitated comprehension of the classroom discourse. For some students, the amount of information provided by C-Print made a significant impression regarding the classroom dialogue. One student described his experience this way:

Well, I would say that it helps a lot. And it surprised me because I never realized how much information was provided in class. Before I always thought that the teacher did not provide enough information and it was boring, but when I was using the C-Print it seemed more interesting. It makes me feel like I have been missing something in the past. Like I missed the last few years.

In terms of understanding the lecture, the only real criticism stemmed from an inability to understand other students' comments. Interviewees attributed this to the fact that the C-Print captionist had trouble hearing the other students' comments because the students did not speak

up or because they could not be heard over competing noises, such as keyboard noise or sounds coming from a nearby construction site.

Information Captured by C-Print

While students felt, for the most part, that they were understanding the lecture, we also asked students during the interview whether students felt that the C-Print captionist was capturing all the information presented in class. An overwhelming number of students felt that the C-Print captionist was capturing all the information. Two exceptions were mentioned, however. First, at least 6 students were aware of the fact that they were missing out on other students' comments. Students also recognized that professors sometimes spoke too quickly for their comments to be typed verbatim. In addition, one student mentioned that C-Print was not capturing graphs, formulae, or other visual information.

The interviewer pointed out to the students that sometimes the C-Print captionist needs to summarize in order to capture the information. A few students were surprised to learn this given the quantity of text displayed. However, most students were fine with summarization as long as the important information was captured. When questioned specifically about whether C-Print was getting the important points, most students agreed that C-Print fulfilled this task. Thirty-one students who answered the questionnaire item pertaining to this issue unanimously agreed that C-Print captured the important information in the summary. Although the C-Print captionist condenses what is being said and does not type every word that is spoken, some students felt that the information was so complete that it had a verbatim-like quality. In the in-depth interview, one student commented:

> *(For a course served by C-Print alone) I would understand everything that is going on in that classroom at 100% because everything would be recorded.*

From the questionnaire data, all students (for whom data were available)) reported feeling that the summarization done by the C-Print captionist was acceptable and that they were getting the important points of the lecture (chi square (1) = 31, $p < .001$).

A student responded to an interview question about the extent that the captionist summarized information as follows:

> *Yes, I accept that it is summarized. I can hardly tell if it is summarized. It looks like she is just typing every single word that the teacher is saying. I can hardly tell that she is summarizing. When I look at the interpreter, I can tell that they are summarizing. So I can see the difference.*

Students did stress, however, that there were times when verbatim transcription was preferable. For example, students preferred to have verbatim transcription of other students' comments or important messages from the professor:

> *Student: And most important things that the teacher says that it is important to know this word or sentence then the person really needs to type that down, it really needs to show up on the screen those important words.*
>
> *Interviewer: So if the professor says, "This is important to know" you want that exact sentence typed in? Because you want to know that the professor said it was important, right?*
>
> *Student: If the professor says something important you really want to know that, you really want to have those exact words on there or for an announcement like it is time for a test time, for final exams, you want that specific information is really important. I don't want to show up at the wrong place at the wrong time or something like that. That would be upsetting.*

In other words, summaries are fine except in certain situations when the exact information is vital to a student's success.

Class Participation

Students' comprehension of in-class proceedings appears to be increased by access to C-Print. However, enriched learning often occurs due to classroom participation as well as comprehension.

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We were interested in knowing whether students could tell, from the C-Print display, when the professor was asking a question. The majority of students could tell. Several commented that a question mark appeared in the text display. Others commented that they noticed a dialogue occurring between teacher and student in the display.

However, one student commented that she was not able to detect a question posed to the class by watching the display because C-Print does not use intonation to distinguish statements from questions. Other students did not pick up on questions because of the lag time associated with the real-time display. As mentioned previously, in those cases, students may have realized that a question was asked but by the time they read the display, the time for answering the question had passed.

We also asked students how they would feel using C-Print to relay their questions to the teacher or comments to the group. For example, interviewers suggested to students that they might type a question and the C-Print captionist could voice for them, or the comments might be displayed for all to read on a TV monitor. Several students thought this strategy would work, but others were less certain as this would be an extreme deviation from current practices.

Comparison of C-Print and Interpreters

Comprehension. Students were asked to consider their comprehension with C-Print as compared to an interpreter. A few students felt both services were comparable. However, many more students reported that with using C-Print they felt they understood more. From analysis of the questionnaire responses, students felt they understood a higher percentage of the class lectures using C-Print compared to using an interpreter (Paired t test, $t = -2.43$, $p < .025$). The mean percentage of lecture information understood using an interpreter was 69.9% (SD = 28.4%), whereas the mean percentage using C-Print was 84.8% (SD = 16.5%).

Reasons for better comprehension of the lecture using C-Print varied by student. For example, some students are less proficient in ASL and thus the interpreters are difficult to understand. Second, the interpreters' skills vary and sometimes they miss information. Third, several students commented that they felt interpreters sometimes missed information because of their condensing strategies. Fourth, several students felt C-Print includes more of the actual vocabulary used by the professor and that this was beneficial for test preparation and learning the course material.

During their interviews, some students stated that they perceived the information provided by C-Print as more complete than that provided by an interpreter. As one student said:

> *I am a fifth year student. I have experienced many interpreters, and I know that I have missed a lot of information. I have seen them do it. And I know that on the C-Print that all the information is there.*

One issue may be the modifications that the interpreter makes to facilitate the signing of the information and to support lipreading. Another student commented:

> *When I watch the interpreter and the teacher, I know that the interpreter is changing what the teacher is saying a lot, and I don't like that because I feel I am losing a lot. Most of the time I will ignore the interpreter and pay attention to the teacher. Some interpreters I have had a few times, and I know if they are good or not. So it depends on the interpreter.*

On the other hand, some students favored the "translation" of technical terms by the interpreter. In this case, they felt they learned more by watching the interpreter because the interpreter describes more of the classroom activity than is captured by C-Print. One student described her feelings this way:

> *I would like to add that why I only looked at the in classroom thing for only five minutes, because the interpreter has expression and I have a better sense of what is happening in class. From the C-Print it is just kind of blank. There is nothing there. People are laughing and I don't know it, people are moving, things are happening in class and I can't realize it. And so I only watched the in class thing, the display, for five minutes.*

Problems or concerns regarding real-time display. Students recognized the limitations of having the C-Print real-time display in class, as opposed to an interpreter. Interpreters add a more personal touch. With an interpreter, the students watch an individual conveying the message, rather than reading text. Also, for a student without intelligible speech, participation in class may be more difficult when only the C-Print service is provided. As one student commented:

> *The only problem I would see is if I don't have an interpreter--what if the student has a question? How would they ask? Or maybe the student could type the question and it appears on the screen...and the teacher can see the screen, and then they know what the question is.*

Best class settings for C-Print vs. interpreters. Students were asked to consider in which class settings C-Print was most helpful and in which settings an interpreter would be most helpful. Several students felt that C-Print was most helpful in lecture-only classes. But at least two students appreciated C-Print in their discussion-based classes as well because the C-Print notes provided a transcript of the discussion. Two different students supported the idea of an interpreter for discussion-based classes. Clearly, there is no one solution to this dilemma.

C-Print as a stand-alone service. Two hypothetical scenarios were presented during the interview. Students were asked to think about the acceptability of using C-Print in the classroom without additional support from an interpreter or on a stand alone basis, without an interpreter or notetaker.

Thirteen students felt comfortable with the thought of no interpreter. However, there was some concern raised about how students would ask questions without the aid of an interpreter.

Eleven students also felt comfortable about using C-Print as a stand-alone service. Several students expressed confidence that they would understand everything if they had C-Print

alone. In contrast, seven students felt that C-Print alone was not a viable option. In fact, one student said that if confronted with the prospect of C-Print as a stand-alone service, he would drop the course.

As evidenced here, for certain students and in certain circumstances one service may be more useful than another. Students expressed the opinion that C-Print and interpreting services are complementary. For example, at the current time, group discussion seems to be captured better by interpreters while students felt that C-Print notes helped them remember what happened in class better than the interpreter could.

C-Print Notes

An important component of the C-Print system is the set of notes produced and distributed to the students. For this interview, students were polled about their preferences concerning receiving the notes, how they use the C-Print notes, and the advantages or disadvantages that students perceive concerning C-Print notes.

Note Distribution Preferences

For this study, C-Print captionists would edit the notes after class and they would be distributed to students via mail folders or at the start of their next class meeting. We questioned students about their preferences for when and how they receive C-Print notes given their experiences with the project.

Preferred time to receive notes. At least 10 students were comfortable receiving their notes the day after class. However, seven students expressed frustration with having to wait so long. They preferred to receive their notes within an hour or two after class ended. Receiving notes the day after class was particularly challenging for those with Monday-Wednesday-Friday classes. This student explained a predicament shared by several others:

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> *...You need to be getting them (the notes) on time. The class is Monday, Wednesday, Friday; I tend to get the notes on Tuesday and Thursday. That means Tuesday I get them from Monday. Thursday from Wednesday. Friday's notes I am stuck. I prefer getting notes after the class, immediately after the class. That way on the weekend I could read the notes from the whole week. And I can summarize for myself what happened during class so I can know. But I am really stuck without Friday's notes.*

Student input suggests that the timing of the distribution of notes ought to be flexible and sensitive to the course meeting times.

Preferred distribution method. A second distribution consideration pertains to the medium of the C-Print transcript. Would students rather have a paper copy of the notes, placed in the student's mail folder, or an electronic copy, disseminated through the campus computer system? Students overwhelmingly preferred hard copies of the notes placed in their mail folders by the C-Print captionist.

Thirty out of 36 students responding to the questionnaire preferred to have the C-Print notes distributed as a paper copy, 5 preferred distribution through electronic mail, and one student declined to indicate a preference, stating a desire for distribution by both methods.

Of the 19 students who voiced their preferences on this topic in the interviews, only two would opt for the electronic mail if given a choice. These two students felt that e-mail transmission would allow them to get the notes at any time, decide whether or not to print the notes (thus saving paper), and allow the notes to be edited with greater ease.

For the majority of students a paper copy was still the first choice for a variety of reasons. Several students expressed distrust of the computer, and had concerns about accessing the computer or printer of they didn't own one. Many students suggested that printing the notes from the computer would be a hassle that they would rather avoid.

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Students who expressed a preference for paper copies of the notes also liked the physical properties of the medium—its portability, ease of manipulation, and readability. Two students described their feelings in this way:

> *If you use the VAX then how would you print it? Some deaf people have printers, others don't. You have to go all the way over, look for some place that has a printer; that would be negative. Asking if you prefer the VAX or hard copy, I prefer the hard copy for myself. It is easier, I can pick it up, I can read it, but it would be frustrating not to have a print copy to work with.*

****

> *I: Let's imagine no technology problem with the VAX...Would you be comfortable with that or would you still prefer the paper?*
>
> *S: I would still prefer the paper copy. That way I could write notes on it our highlight it. It would be hard to study from the computer.*

C-Print Notes as Study Tools

Usage and usefulness. On the questionnaires, students rated the C-Print notes on how helpful they found them. Due to the small number of subjects, the four rating categories were collapsed into three for analysis purposes: "helps little or none," "helps enough," and "helps very much." A higher number of students (33 out of 36) rated the C-Print notes as helping enough or very much (chi square (2) = 15.17, $p < .01$).

Twenty-four out of 34 students responded that they used the C-Print notes more than the notes from the notetaker. This demonstrated a significant difference in usage frequency (chi square (1) = 5.76, $p < .02$).

Students were asked about how often they would read a set of C-Print notes. Some students did not integrate reading C-Print notes into their regular study routines. As one student remarked "...It is going to take the time for us to fully adapt to C-Print." Other students made the transition to C-Print notes more easily, and read the notes regularly, between 1-3 times for each set of notes.

But how are students actually utilizing the C-Print notes? We asked students to describe their study habits and how they use the C-Print notes. From the 36 students responding to the questionnaire inquiry about how they used the C-Print notes, 29 students reported skimming the notes, 16 reported noting unfamiliar vocabulary and ideas, only 10 reported using the notes to create their own outline, while 14 reported "other" uses of the notes, such as rereading.

Similarly, in the interviews, students reported using the C-Print notes for study in a variety of ways: (a) skimming the text; (b) reading and rereading the text; (c) noting special vocabulary; and, (d) making an additional set of personal notes. One student reported using the following strategies in studying notes:

> *I just read them to see if I know the information. And I know that, know that, fine, no problem. And then I get to something I have not seen before, then I mark it, I mark it up. And then I continue reading, and then I go over it again to figure out what they are talking about, and try to understand everything that is going on. And then like words I never saw before or heard before, I underline. And then I write an explanation about what it means. And I use that for tests. Yes, it helps a lot. It has really pulled my grades up a lot.*

The methods described above suggest that students use the notes in many ways. Students' study techniques might be best characterized on a continuum from passive to active approaches based on the degree to which they manipulated the notes to fit their needs.

Passive approaches. The most basic passive approaches with the C-Print notes involved reading strategies alone. For example, several students looked at the notes only on occasion and just skimmed the notes. Many students said that they read them more thoroughly. Thorough reading was a method frequently mentioned. Still other students compared C-Print notes with notetaker's notes, the textbook, or their recollections of class lecture and discussion. C-Print notes were also used as additional reference to prepare for tests and class projects.

Active approaches. Active use of the C-Print notes can be characterized as those strategies that involve some manipulation of the notes. For example, many students said that

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they would read over their notes and write additional notes or questions for the professor on the margins. Several other students used the C-Print notes as the basis for writing their own outlines or course notes.

Content of C-Print Notes

We asked students to reflect on the content of C-Print notes in comparison with notetakers' notes. We also requested students to give us their opinions about the advantages and disadvantages of C-Print notes. In many instances, the comparisons and advantages/disadvantages echo the same sentiments. This section combines and summarizes those responses according to the following categories: (a) clarity of notes; (b) structure of the notes; (c) adaptations that need to be made based on experiences with C-Print; and, (d) benefits to the class as a whole.

Clarity. Many students commented on the clarity of C-Print notes as compared to those of the average notetaker. Clarity meant several things to the students. For example, one student emphasized the legibility of the typewritten notes as opposed to the handwritten notes:

> *Well the best part about the notes is that they are clean and they are clear. They are easy to read, they are legible. Other notes that are handwritten notes, sometimes you can't always decipher the writing. That's a little bit too complicated. With the notes, they are easy to understand.*

A second meaning of clarity, and a far more common one, was the idea that the great amount of detail included in the C-Print notes made the notes easier to understand. In contrast, students characterized notetakers' notes as being more brief and sketchier.

The detail of the C-Print notes means that students have an easier time studying, more exposure to actual vocabulary presented in lecture, and a better sense of the overall classroom experience. These points were viewed as advantageous by the students. One student quipped that reading the C-Print transcript was "almost like having a tape recorder in class. You can

always refer back to what was going on in lecture." Having the near-to-verbatim transcript also aids students in preparing for class assignments. For example:

> *Some of the positive things...if I want to go back and see what the students in class said that helps me a lot. From one of my classes, Women in Contemporary Society, we had to write reaction papers. We had to give our thoughts about class the previous week. We would give feedback and opinion and stuff and sometimes I need to know what the students are saying, I need their feedback to help me write my papers. That helped a lot to be able to go back and see what the students said. Because the notetaker did not include that because there are just too many student comments. So that was one positive thing.*

Structure. The structure of C-Print notes was viewed equally as an advantage and a disadvantage by students. Notetakers' notes come to the student in outline form. In addition, sometimes very important points are highlighted or otherwise accentuated for their importance. In contrast, the C-Print notes are a relatively unadulterated transcript of class proceedings. If the professor digresses during lecture, that is reflected in the transcript. Student comments are also reported as is. For some students, the transcript-style text contains too much information and it is overwhelming. Other students welcome the opportunity to extract information for themselves:

> *I love the C-print notes because I have been in a lot of classroom situations where we have notes takers (sic) and they pick and select. These notes takers may have never taken this course before, but these notetakers they decide what is important, what is necessary to know, how much should be done, whether this piece of information is important or not. They decide and that is what we get. What they decide is important. And C-Print that completely eliminates that because all of it is there. It is not what is important and what is not. We get the notes basically in paragraph form and we have to weed through and we the student picks (sic) through and decide what we need to know. Do we need to know that the teacher was sick all weekend or do we need to know that we have a test tomorrow, what is more important.*

Disadvantages of the C-Print Notes

Most of the students had a difficult time identifying any disadvantages of C-Print notes. Three disadvantages were mentioned by several students, however. These can be grouped together based on the notion that an adaptation or adjustment needs to be made in the future

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either by the student or within the C-Print system itself. Four students commented that the length of their notes increases their study time:

> *They have a lot of good information, a lot of detail to them, but they are so very long. Reading all of them it takes a lot of time to do that, compared with, you know, I have all these reading assignments with the course as well, so it just takes a lot of extra time.*

****

> *...I prefer the notetaker...The time is very valuable, and it can sometimes be 10 or 11 pages that we have to read from the C-Print, and sometimes that is just too much. So the notetaker's notes are more summarized, a little bit more brief. And that is something that I prefer over the C-Print notes.*

The length of the notes also raised some concerns about the quantity of paper used and difficulties in managing that paper. This is how one student characterized her experience:

> *The other negative is that it uses papers and that applies to the notetakers' notes too. Sometimes it is a pain to have all those papers, and then I have to punch holes in them and put them in my notebook and everything and it makes a lot more work for me.*

Both the length of the transcript and the quantity of paper produced require students to change their expectations about study time and storage issues.

The final disadvantage mentioned by students requires adaptation of the C-Print system. Several students commented that while notetakers will copy board work or other graphics or visual material, C-Print cannot. This limitation decreases the practicality of using C-Print in certain classes. For example, one student described his frustration in an art class this way:

> *The disadvantages—so far I haven't seen too many. Maybe one. Maybe people aren't drawing enough pictures. Say we are looking at a slide and we need to study the slide and catch the icon of it. But there is not a picture, there is a picture lacking on the page. If it had the picture added, it would be an additional benefit. For art majors especially, they need to know what the images look like, the visualization of the images. Again, with slides its especially important, especially for the art majors.*

Other Benefits of C-Print Notes

Some students noted that they were able to get an overall sense of the sequence of ideas in a class, as indicated by the following exchange:

> *Interviewer: The C-Print paper notes. What are the advantages, the benefits of the C-Print notes on paper?*
>
> *Student: For me it helps me to remember the flow of the class discussion. When I review it for studying, I pick out the key points. I find that better than the regular notetaker, because the regular notetaker is really summarizing everything. This, it gives the flow of the class so that helps a lot.*

Up until now, the major benefits of C-Print have been discussed with regard to the deaf student only. In particular, students have described an increased awareness of vocabulary and discussion, and they have noted how course content is elaborated in the C-Print transcripts as opposed to traditional notetakers' notes. In addition to use as a service for deaf students, it appears that in some courses, the benefits of C-Print spill over to the entire class:

> *My teacher has really been praising Joyce in class. She likes to keep a copy of the C-Print notes for her own personal reference in the library. That's how good the notes are. If other hearing students have a question, they can get a hold of the teacher for her C-Print notes. It's just not for the deaf students. The hearing students can also take advantage, and the teacher is able to take advantage of the service that's being offered too.*

The above quote seems to suggest that in situations where the professor is supportive, C-Print can become an integral part of class that can be utilized by all, not just some, of its students.

Relationship between Perceptions of C-Print and Communication Characteristics

This study also examined the relationship between perceptions of C-Print and communication characteristics of individual students. To examine this relationship an index of the extent that students responded favorably to C-Print was created by combining scores for three questions: (a) "How helpful is C-Print without the notetaker?" (range of scores 2-4); (b) "What percentage of the lecture was understood with C-Print?" (range 50-100); and, (c) "How

much did C-Print notes help with the course?" (range 2-4) To give responses to these questions equal weight in the index, we applied a z-score transformation to individual students's responses to these questions. We then created a C-Print "index" for each student by adding together the three z-scores for that student.

This index was correlated with scores on five communication skills tests. Relatively favorable responses to C-Print were associated with higher scores on the Michigan test of English proficiency ($r = .51$, $p < .05$, $N = 25$), with higher scores on the NTID test of speech reading with sound ($r = .57$, $p < .01$) and with higher scores on the test of speech reading without sound ($r = .59$, $p < .01$). The C-Print index did not correlate significantly with the skill measures of the California reading comprehension test, or the simultaneous communication test. The C-Print index also did not correlate significantly with high school background (there was little variation), hearing loss as measured by pure-tone average, the Language Background Questionnaire self-rating of sign proficiency, or college grade point average. Thus, preference for C-Print appears to be associated with being skilled in English and in receiving spoken (e.g., English) communication.

Overall Evaluation of the C-Print System

On the questionnaires, students rated how helpful the C-Print system would be in a hypothetical classroom situation where there is not an interpreter or notetaker present. Due to the small number of subjects, the four rating categories were collapsed into two: "help little or none" and "help enough or very much." A higher number of students (24) rated the C-Print system as helping enough or very much as compared to the number of students (2) who rated the system as helping little or none (chi square (1) = 7.92, $p < .02$).

The student interviews revealed that the key benefit of C-Print is that it provides complete information regarding what was discussed in class, as the following quotation reveals:

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> *You said one situation is you have a notetaker and you have an interpreter. The other situation is that you have C-Print only, right. I would prefer the C-Print only. Yes, I would get all the information, and with an interpreter I may miss some information, and the notetaker may miss some information or may only do summaries. With C-Print I am getting everything, and I can see it on the TV screen or on the laptop, and I can summarize it myself if I want to.*

This completeness of information appears to compensate for some of the limitations of the system, such as the lack of personal contact and the support for participating in class provided by an interpreter.

Discussion

The evidence of this study indicates that many deaf and hard of hearing students responded favorably to the form of information delivery provided by the C-Print speech-to-print transcription system. Students perceived the system as providing very complete information by capturing all or almost all the important points and details, and as giving this information permanence. For the real-time display on the laptop that is presented during class, each row of words remains on the screen for approximately a minute, providing students far more time to consider these words than if they were using an interpreter or lipreading a speaker. After class, students can further review the material in exactly the same wording and in much greater detail than notes from a notetaker.

The results of this study are similar to those of a study conducted during the 1980's at NTID with a steno system (Stinson, Stuckless, Henderson, & Miller, 1988). In the previous study and the present one, deaf students assigned higher ratings or understanding to the transcription system (C-Print or steno) than to interpreting. In addition, more students responded favorably to the hard-copy text than to notes from a notetaker in the present study. These results are consistent with those of the previous study in which students rated the printout of the text from the steno system more favorably than the notes from a notetaker. Why might

students find the printout more helpful? Comments during interviews for the present study, as well as from the previous study, suggest that the detail of the printout permits clarification of what was not understood during the lecture. Furthermore, while the content of notes varies among notetakers, the printout represents a transcription that approaches verbatim. The results from this study suggest that the C-Print system can get equally favorable evaluations as a steno system, however, C-Print is more cost effective due to its shorter training time (app. 1 month) and lower equipment costs.

There is a need to do more analyses of the current data, to try to evaluate the C-Print system with other kinds of classes, and to increase the sample size and representation.

The relations between communication background and preferences and response to C-Print seemed consistent with previous research. Previous research with steno systems found that students who came from mainstream high school programs and who were relatively proficient in reading, writing, and speech reading tended to prefer the transcription system. On the other hand, students who came from residential/day schools, who were relatively proficient in manual reception but less proficient in auditory discrimination, speech reading, and speech production, were likely to prefer an interpreter (Stinson et al., 1988). A similar pattern of relations occurred in that students who were proficient in speech reading and English responded favorably to the C-Print system.

In addition, the system has been examined with limited kinds of classes, primarily lecture-oriented courses in business or liberal arts. For certain class settings, such as laboratories, the system may be inappropriate (Haydu & Patterson, 1990). The study's conclusions need to be further qualified by the small sample in which approximately half of the students serviced by C-Print completed questionnaires or interviews. It is possible that students who participated in the study had more favorable attitudes about the system.

C-Print is not a panacea for overcoming communication barriers faced by deaf and hard of hearing students. No single channel of receptive communication (e.g., speech reading, sign reception, reading) can be entirely suitable for all deaf and hard of hearing students under all conditions. Evidence is accumulating, however, which indicates that a transcription system such as C-Print is an effective way of increasing accessibility to information in the classroom.

As part of the C-Print project, students' input was solicited based on their experiences with the system. The interviews focused on the two major components of the C-Print system—the real-time display and the C-Print transcript of class proceedings.

Overall reaction to the real-time display was very positive. Students preferred the laptop display over the TV monitor, and they preferred a double-spaced display to a single-spaced one, with an easy-to-read, large-sized font. While most students recognized occasional errors, they were sympathetic to the captionist's plight and preferred some errors to missing information and having all the words spelled perfectly. Students were also enthusiastic about their level of comprehension of lecture material with C-Print. Despite their enthusiasm for the system, students did criticize certain aspects of the C-Print display—namely, lag time, captionist's difficulty capturing other students' comments, and C-Print's inability to capture visual material such as illustrations or mathematical formulae.

Students' feedback about the C-Print notes reflected a diversity of opinions. For example, students were split on their opinions about when they should receive their notes—shortly after class or within 24 hours. In contrast, 17 out of 19 students preferred to receive a paper copy of the notes as opposed to receiving the notes through the VAX campus computer system.

C-Print notes appear to be versatile in their usefulness as a study tool. The notes were read, highlighted, and written upon. They helped students to recall class proceedings and were used to study for tests and to compose papers.

Students were hard-pressed to identify disadvantages of the C-Print notes. The few students who did criticize the notes were concerned with the length of the transcript and the amount of time needed to read the notes, the quantity of paper used for printing notes, and the lack of illustrations or other graphic information.

Students were generally very pleased with the content of C-Print notes. Many commented on the clarity and detail of the notes. Students recognized the benefits of the notes to themselves and to others in class.

From the perspective of the students, the C-Print system appears to enhance their educational experience. This student's comment reflects the thoughts of many students who were interviewed:

> *Interviewer: What is the best thing for you about C-Print?*
>
> *Student: For me, confidence. I have more confidence and I learn more. I'm able to do the assignments better.*

Chapter VII

Pilot Study of C-Print in the High School Setting

Lisa Elliot and Michael Stinson

While most of the work in the project was done at the postsecondary level, the project also explored the potential of C-Print with mainstreamed secondary school students. In addition to students using the information provided by C-Print directly, support staff and faculty may find the printout helpful in reviewing with the student what has happened in class. Learning experiences in high school are often different than those in college. For example, in high school there may be less direct lecturing and more emphasis on group activities and discussion. With these differences in mind, one goal of this pilot study was to collect information that might suggest ways for modification of C-Print in the high school setting, relative to the college one. In addition, the reading level of secondary students might affect these students' ability to read and understand the real-time display and the C-Print notes. We want to determine if these considerations were also important.

A pilot study was conducted using the C-Print service in two local high schools. Both students were male and regularly had notetaker support services, but no interpreters. One student, a senior, received C-Print services for four class meetings of AP History or Law and Government. The other student, a junior, received C-Print services seven times for his English class. Summaries of interviews with the students, their classroom teachers, their tutors, and a notetaker are presented here.

Student Interviews

Methods

Students were interviewed at their high schools. Interviews were approximately 30 min long and were audiotaped. Four common themes emerged from the student interviews: (a) satisfaction with the real-time display features; (b) preference for attending to the teacher; (c) preference for quick turnaround of the notes; and, (d) recognition of differences between notetaker's notes and C-Print notes.

Results

Satisfaction with Real-Time Display Features

Both students found the laptop easy to read. Neither had any suggestions for changing it. However, one student suggested that a TV monitor display would be of greater benefit to the class because everyone would have access to the real-time service. The student felt that seeing the display would help everyone keep track of what was being said in class.

Preference for Attending to the Teacher

Despite the students' satisfaction with the laptop display, both students still preferred to watch the teacher. As one student explained:

> *I tried to watch more of the teacher. Just because when you watch the teacher you feel like you are more a part of the class and when you watch the laptop you connect more with the laptop.*

Students used the laptop display only as a backup when they felt they missed something the teacher said. However, by utilizing the C-Print display in this limited fashion, the students still missed many student comments which would have been displayed while they were looking at the teacher only.

Preference for Quick Turnaround of Notes

Both students also expressed a preference for receiving C-Print notes on the same day as class. In fact, the sooner after class, the better. As one of the students put it:

> *Just get them (the notes) when you get them to me. I like them that day though. That way when you do your homework, you know what they are talking about, because 2 or 3 days later it means nothing.*

The preference for receiving notes on the same day as they are recorded is slightly different from most college students' preferences, who only ask to receive their notes within 24 hours of class. This difference in preference is probably due to the fact that high school students attend their classes Monday through Friday, whereas the college classes that C-Print has served meet less frequently. Therefore, while the demand on the captionist intensifies in the high school setting, the meaning of the students' wishes in high school and college are essentially the same: that they receive notes in a timely fashion that corresponds to their class schedule.

Recognition of Differences Between C-Print Notes and Notetaker's Notes

It was obvious to the students that C-Print notes were unlike notes they were used to receiving. The students described C-Print notes as being much longer and more detailed than notes from their notetakers. C-Print notes also arrive "unedited." As one student described the notes:

> *The advantage of the notes is that they are very detailed. The disadvantage is for me I prefer the handwritten notes because when the notetaker takes the handwritten notes she does half my job for me. She picks the most important information. But still it is just because I believe in my notetaker and trust her and her judgement.*

For this student, comparing the two sets of notes was difficult because he had an ongoing relationship with his notetaker. In addition, the notetaker went beyond merely recording and presenting important information but was actually having a dialogue with the student through the notes. It would be difficult to disentangle the emotional and social components of such a

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relationship and to therefore objectively weigh the advantages and disadvantages of the two systems.

For the other student, the length and depth of the C-Print notes appeared to be a turnoff for two reasons. First, the student found the extra time required to read the transcript and prepare his own notes added more time to his 3-4 hours of homework each night, and that this was not productive time. Second, the student objected to the near-to-verbatim transcript because it included, in his perception, much irrelevant information. For example:

> *Some of this stuff isn't really needed, like if a student (says) something that is not really needed. There's too much stuff that isn't needed. Its just not really good. That's why the (notetaker's) notes are a little bit better, it's just what you need, but it's not everything.*

From these exchanges, it appears that while students were exposed to additional information, they were not necessarily coached on what to expect from the C-Print system or how to use the information that they received.

Discussion

In this brief exposure to C-Print, students were satisfied with the quality of the visual display, however, they both admitted that they preferred to attend to the teacher.

With regard to the C-Print notes, students preferred to receive notes as quickly as possible. This can probably be attributed to the students' class schedule where classes convene on daily basis. This need heightens demands on the captionist, but can be accomplished.

Finally, students expressed conflicting feelings about the content of C-Print notes. While they were more complete than notetaker's notes, they lacked the personality and editorial touches of the notetakers. In addition, the increased quantity of text raised the students' workload and it was unclear as to whether the students received any direction as to how to handle the extra information.

From the small amount of information gathered here it is apparent that further work at the high school level might involve: (a) coaching on appropriate use of the display; (b) fostering relationships between the operator and student in the same vein as the notetaker's relationship with the student; and, (c) instruction on the best ways to utilize C-Print notes.

Tutors' and Notetaker's Interviews

Methods

Two tutors (teachers of the deaf) and one notetaker were interviewed. Analyses of the interviews revealed a variety of topics including: (a) ideal type of class for the C-Print service; (b) ideal type of student to receive C-Print services; and, (c) the value of C-Print for building reading skills. In addition, the tutors and notetaker discussed the role of the captionist in providing support to the student, and the role of student involvement with the C-Print service.

Results

Consistent Themes in All Three Interviews

Ideal class for C-Print services. All three interviewees described a similar model for the ideal C-Print class. This class would be lecture-based and college-oriented. In addition, the ideal class would introduce a great deal of new vocabulary or unfamiliar names. One tutor felt C-Print would be valuable in these types of classes due to the immediacy of the C-Print display, as she explains here:

> *Without knowing a whole lot about C-Print and without having seen it used in different types of classes, I would think it would be really beneficial in Social Studies classes, where proper names and places are given out, really unfamiliar vocabulary. So not only is the student hearing it, but can see it in print right away and not have to wait until that evening or after class to see it written down. I think it might help them focus in on the lesson better right from the very beginning....I would think that that would be very beneficial.*

Ideal type of student to receive C-Print services. The interviewees were also in agreement about the type of student who would be best served by C-Print services. An appropriate student would be someone with sufficient reading skills and who is motivated to be a good student. These students might also be identified as "college bound" or "college material." Finally, appropriate students for C-Print would need to be comfortable simultaneously apprehending information from multiple sources.

C-Print's role as a vocabulary builder. The interviewees viewed C-Print as a tool for increasing students' vocabulary. As noted in the quote above, students would be able to see new vocabulary during class on the C-Print display, which provides immediate reinforcement for new words or names. It was also suggested that during the editing process the captionist could define new words for the students, for example, in the margins of the notes.

Limited exposure to C-Print notes. While the students received copies of the C-Print notes, the tutors did not receive them with the students or spend much time working with the students on the notes. In the circumstances of the two students in this pilot study, both were strong students and it appeared that the tutors did not really emphasize working with class notes in general. Perhaps if the tutors had more exposure to the notes they would have spent some time working with the students to develop successful strategies for using the notes.

Additional Issues

Captionist support of students. When questioned on the best ways for the captionist to support students using C-Print services, there was some disagreement on the best approaches. For example, the notetaker felt that "She seemed pretty busy getting everything down. I'm not sure what she could do." In contrast, one of the tutors suggested that the operator should be working with the student outside of class to develop productive strategies for using C-Print.

Student involvement. Interviewees also made various comments about student involvement with C-Print. For example, one tutor and the notetaker noticed that their students tended to pay less attention to the teacher with the C-Print display than he did with his notetaker only. Another interviewee, thinking out loud, said that while it was probably not cost effective, the captionist could take the time to get to know the student better by following her or him around during the school day. Finally, one notetaker and tutor suggested that it would also be beneficial for the hearing students in the classroom to have an orientation about C-Print. They felt the students would be interested in the technology and accepting of its implementation in the classroom.

Discussion

The tutors and notetaker interviewed considered the usefulness of C-Print in particular learning situations and with certain students. They felt that the students who could benefit the most were college-oriented students who were enrolled in college-preparatory classes. They viewed C-Print as an asset to vocabulary building both through the real-time display and C-Print notes. None of these support staff spent much time reviewing the C-Print notes themselves or with the students. It is possible that future successes in the high schools will depend upon a more thorough utilization of the C-Print notes.

The interviewees also voiced different opinions as to the role of the captionist in working with the student and the various ways in which to involve students with the C-Print system. As expertise accrues with time, input such as this will be implemented to enhance C-Print's service in the classroom.

Classroom Teachers

Methods

Brief interviews were held with the students' regular classroom teachers. Two interviews were conducted by phone and the third in person. Four themes emerged from the interviews: (a) feelings about C-Print; (b) C-Print's presence in the classroom; (c) interactions with C-Print students; and, (d) appropriate students for C-Print.

Results

Feelings About C-Print

The teachers appeared to be favorable toward the C-Print service. They felt that it gave students support and that it had the potential to help with peer interaction. Two out of the three teachers did not see any disadvantages to using C-Print. The third teacher was concerned that her student was not taking notes because he received the C-Print transcript. She also commented that the near-verbatim notes contained too much unnecessary information, such as her many digressions from the topic of the day.

C-Print's Presence in the Classroom

C-Print was unobtrusive according to the teachers. They had "no problem" with having the C-Print captionist in class and they very quickly became oblivious to the captionist's presence. Two of the teachers commented that having C-Print in the class did not influence their teaching style at all. One teacher observed a small influence on classroom dynamics, however. In this class, a student asked for his seat to be reassigned because the sound of the keyboard was distracting to him. The teacher also said that this particular student was easily distracted by many stimuli.

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Interaction with C-Print Students

Judging from the interviews, the teachers did not interact with the students being served by C-Print about the C-Print service. C-Print was in the classroom for a minimal amount of time and the teachers did not notice changes in class participation or comprehension of the material due to C-Print. However, both students who used C-Print in this pilot were very good students already, and so improvements in class may have been too subtle for the teacher to notice.

Appropriate Students for C-Print

Classroom teachers were also asked to describe ideal C-Print students. In contrast to the tutors and notetaker, the classroom teachers' definitions were less detailed. Classroom teachers did not identify students by their academic potential (i.e., "college bound"), but focused instead on the student's hearing abilities. Both teachers who were asked about ideal students emphasized that students who would benefit the most from C-Print should probably have greater hearing impairment than either of the two students in the pilot study.

Discussion

The regular classroom teachers were interviewed after brief exposure to the C-Print system. They were very positive about their experience and they perceived potential benefits to the students as well.

Classroom teachers reported that they adapted easily to having C-Print in the classroom. Perhaps, too easily. For example, while they did not find C-Print a distraction, they also did not alter their teaching styles at all. It could be suggested that these teachers actually *ignored* the C-Print captionist and C-Print activities present in the room. Interviews with C-Print captionists, on the other hand, suggest that teachers who acknowledge the C-Print captionist and who integrated C-Print into the teaching process by slowing down their speech or by asking students to repeat themselves, were most helpful to the C-Print captionists.

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Student performance was not noted to improve during the pilot study period, but one student was observed not taking notes. The interviews do not indicate that the teachers discussed C-Print at all with the students in question. This lack of interaction may have led teachers to the conclusion that students were not benefitting from C-Print very much and thus arriving at the supposition that the students who would benefit most from C-Print would have greater limitations on their hearing. If the teachers and students had communicated on the subject, the teachers may have come to different conclusions about the usefulness and appropriateness of C-Print for their students.

Further work with the C-Print system could benefit from greater interaction among the principals involved in implementing and using the system. For example, an orientation that introduces C-Print to the classroom and involves the captionist, classroom teacher, deaf students and hearing students may be helpful. In addition, both the tutors and the students could benefit from working with C-Print investigators to learn more about maximizing the utility of C-Print notes.

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Appendix

Selected Materials Providing Information on the C-Print Project

Listed below are selected, currently available, materials on the C-Print system. Papers that are redundant with information in the final report or with other materials in the list are not included. Contact Michael Stinson for copies or for further information.

1. C-Print Project. (1998). C-Print: A computer-aided speech to print transcription system (Brochure). NTID, Rochester Institute of Technology, Rochester, NY: Author.

2. C-Print Project. (1998). How to become a C-Print captionist (Brochure). NTID, Rochester Institute of Technology, Rochester, NY: Author.

3. McKee, B. G., Giles, P. G., Everhart, V. S., Stinson, M. S., and Henderson, J. B. (1998). C-Print: A computerized speech-to-print transcription system: Captionist training manual. NTID, Rochester Institute of Technology, Rochester, NY.

4. Elliot, L., Foster, S., Stinson, M., and Colwell, J. (1998, April). Perceptions of learning with a speech-to-print system. Paper presented at the meeting of the American Educational Research Association, San Diego, CA.

5. McKee, B. G., Stinson, M., Giles, P., Colwell, J., Hager, A., Nelson-Nasca, M., and MacDonald, A. (1998). Guide for implementing C-Print. NTID, Rochester Institute of Technology, Rochester, NY.

6. Stinson, M. S., Eisenberg, S., Horn, C., Larson, J., and Levitt, H. (1997). Real-time speech to text services. Report to the National Task Force on Services for Postsecondary Deaf and Hard of Hearing Students. NTID, Rochester Institute of Technology, Rochester, NY.

7. Stinson, M.S., and Stuckless, E. R. (in press). Recent developments in speech-to-print transcription systems for deaf students. In A. Weisel (Ed.), Deaf education in the 1990s: International perspectives. Washington, DC: Gallaudet University Press.

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